

ForeRunner™ ES-3810 Installation and User's Manual

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Software Version 4.2.x

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ETL certification to UL 1950. ETL certification to CSA 950.

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- EN 55022 "Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment."
- EN 50082-1 "Electromagnetic compatibility Generic immunity standard Part 1: Residential, commercial, and light industry."
- IEC 801-2 "Electromagnetic compatibility for industrial-process measurement and control equipment Part 2: Electrostatic discharge requirements." Severity level 3.
- IEC 801-3 "Electromagnetic compatibility for industrial-process measurement and control equipment Part 3: Radiate electromagnetic field requirements." Severity level 2.
- IEC 801-4 "Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Electrical fast transient/burst requirements." Severity level 2.

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Acronyms

Glossary

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Preface

The intent of this manual is to supply users of the *ForeRunner*TM ES-3810 Ethernet Workgroup Switch with the necessary information to successfully install and begin using the ES-3810. This document provides general product information, setup procedures, and network configuration examples. This manual was created for users with various levels of experience. If you have questions or problems with the installation, please contact FORE Systems' Technical Support (see page ii).

Chapter Summaries

Chapter 1 - Introduction - Provides an overview of management options for the ES-3810 with a specific emphasis on the Management Console. Also provided in this chapter are the electrical characteristics for the ES-3810.

Chapter 2 - Setup - Guides the user through the installation of the ES-3810 and provides an overview of the switch operation.

Chapter 3 - Hardware Configuration - Explains the layout of the ES-3810's chassis, port numbering scheme, available configurations and modules, and how to install or remove modules and power supplies.

Chapter 4 - Software Upgrade Procedures - Provides information about upgrading the operational and bootstrap software for the ES-3810.

Appendix A - Network Design - Provides information on IP Multicast support (IGMP), LAN Emulation, and network configurations.

Acronyms - Contains a list of common networking acronyms.

Glossary - Contains definitions for networking terms, both general and ATM-specific.

Technical Support

In the U.S.A., you can contact FORE Systems' Technical Support by any one of four methods:

1. If you have access to Internet, you may contact FORE Systems' Technical Support via e-mail at:

support@fore.com

2. You may FAX your questions to "support" at:

412-742-7900

3. You may send questions, via U.S. Mail, to:

FORE Systems, Inc. 1000 FORE Drive Warrendale, PA 15086-7502

4. You may telephone your questions to "support" at:

800-671-FORE (3673) or 412-635-3700

Technical support for non-U.S.A. customers should be handled through your local distributor.

No matter which method is used for technical support, please be prepared to provide the serial number(s) of the product(s) and as much information as possible describing your problem/question.

Typographical Styles

Throughout this manual, specific commands to be entered by the user appear on a separate line in bold typeface. In addition, use of the Enter or Return key is represented as <ENTER>. The following example demonstrates this convention:

cd \usr <ENTER>

Commands or file names that appear within the text of this manual are represented in the following style: "...the fore_install program will install this distribution"

Important Information Indicators

To call your attention to safety and otherwise important information that must be reviewed to insure correct and complete installation, as well as to avoid damage your system, FORE Systems utilizes the following *WARNING/CAUTION/NOTE* indicators.

WARNING statements contain information that is critical to the safety of the operator and/or the system. Do not proceed beyond a **WARNING** statement until the indicated conditions are fully understood or met. This information could prevent serious damage to the operator, the system, or currently loaded software, and will be indicated as:

WARNING!



Hazardous voltages are present. To lessen the risk of electrical shock and danger to personal health, follow the instructions carefully.

CAUTION statements contain information that is important for proper installation/operation. **CAUTION** statements can prevent possible equipment damage and/or loss of data and will be indicated as:

CAUTION



You risk damaging your equipment and/or software if you do not follow these instructions.

Preface

NOTE statements contain information that has been found important enough to be called to the special attention of the operator and will be set off from the text as follows:



Steps 1, 3, and 5 are similar to the installation for the computer type above. Review the previous installation procedure before installation in your particular model.

Laser Notice

Class 1 Laser Product: This product conforms to applicable requirements of 21 CFR 1040 at the date of manufacture.

Class 1 lasers are defined as products which do not permit human access to laser radiation in excess of the accessible limits of Class 1 for applicable wavelengths and durations. These lasers are safe under reasonably foreseeable conditions of operation.

Every ES-3810 with a fiber optic interface contains a Class 1 laser.

Safety Precautions

For your protection, observe the following safety precautions when setting up your equipment:

- Follow all warnings and instructions marked on the equipment.
- Ensure that the voltage and frequency of your power source matches the voltage and frequency inscribed on the equipment's electrical rating label.
- Never push objects of any kind through openings in the equipment. Dangerous voltages may be present. Conductive foreign objects could produce a short circuit that could cause fire, electric shock, or damage to your equipment.

Modifications to Equipment

Do not make mechanical or electrical modifications to the equipment. FORE Systems, Inc., is not responsible for regulatory compliance of a modified FORE product.

Placement of a FORE Systems Product

CAUTION



To ensure reliable operation of your FORE Systems product and to protect it from overheating, openings in the equipment must not be blocked or covered. A FORE Systems product should never be placed near a radiator or heat register.

Power Cord Connection

WARNING!



FORE Systems products are designed to work with single-phase power systems having a grounded neutral conductor. To reduce the risk of electrical shock, do not plug FORE Systems products into any other type of power system. Contact your facilities manager or a qualified electrician if you are not sure what type of power is supplied to your building.

WARNING!



Your FORE Systems product is shipped with a grounding type (3-wire) power cord. To reduce the risk of electric shock, always plug the cord into a grounded power outlet.

CHAPTER 1

Introduction

Based on a next-generation, distributed, store-and-forward switching architecture, the ES-3810 provides users with the ability to configure multiple switched Ethernet ports (both 10 and 100 Mbps) as needs grow. The ES-3810 also provides high-performance ATM server and backbone connections to take advantage of powerful advanced network management.

1.1 ES-3810 Configuration

The following figure shows the front panel of the ES-3810.



The figure below represents ONE possible configuration of the ES-3810. Numerous other configurations are possible, depending on which ES-3810 modules are used.



Figure 1.1 - The ES-3810 Ethernet Workgroup Switch

1.1.1 Dual Power Supply Chassis

The new ES-3810 chassis supports redundant, hot-swappable, load-sharing power supplies. Each supply utilizes its own power cord, allowing for separate electrical connections. For information about adding/removing power supplies, see Chapter 3.

With redundant power supplies installed, a single power supply failure on the ES-3810 will not cause the switch to stop functioning.

1.2 Processing Sequence

Upon power-up of the ES-3810, a series of sequenced operations are performed as follows:



The following sequence takes approximately 15 seconds to complete. The sequence must be completed before normal ES-3810 local console management activity may commence.

- 1. If a system configuration has been saved on the ES-3810, the NMM restores that configuration; otherwise, the NMM restores the factory default configuration. The configuration which the NMM restores is considered the "current configuration."
- 2. The NMM performs a Power-Up Self-Test (POST) on itself. If the POST reveals any problems, the appropriate information is displayed on the management console.
- 3. The NMM initializes itself using the current configuration, including:
 - IP parameters (i.e., IP address, subnet mask, primary gateway);
 - SNMP Agent Parameters (i.e., system name, contact, and location, access control list, authentication trap enable, and trap destination list);
 - Bridging parameters (i.e., initial filtering mode and maximum address database entry age);
 - Static ARP cache entries;
 - Static IP routing table entries;
 - VLAN database.
- 4. The NMM scans each slot for recognized modules (not including itself). For each module, the NMM performs the following start-up procedure:
 - The NMM performs a POST on the module.
 - If the POST reveals any problems, then the appropriate information is displayed on the management console. Furthermore, the NMM places the module in a reset state so that it does not interfere with the components of the system which are operating properly.
 - If the module POST does not reveal any problems, the NMM initializes the module using the configuration restored earlier in the start-up procedure.
- 5. The NMM starts the IP stack and SNMP agent.
- 6. The NMM starts the IGMP entity.
- 7. The NMM starts interface maintenance.
- 8. The NMM starts the management console by displaying the logon screen.

1.3 ES-3810 Specifications

• Single-power supply chassis specifications indicated by part number **ES-3810**. Dual-power supply chassis specifications indicated by part number **ES-3810/CH**.

Table 1.1 - ES-3810 Specifications

System Specifications			
Aggregate Throughput	720,000 packets per second (pps)		
Latency 61 µs per 64-byte packets (10Base-T)			
Dimensions ES-3810	17.38" (44.1 cm) W x 4.88" (12.4 cm) H x 11.00" (27.9 cm) D		
ES-3810/CH	17.35" (44.1 cm) W x 5.19" (13.2 cm) H x 12.64" (32.1 cm) D		
Power ES-3810	90-264 volts, autosensing: 80 watts		
ES-3810/CH	90-264 volts, autosensing: 110 watts		
Operating Temp.	0 - 40° C		
Weight	14.8 lb. (32.6 kg.)		
Compliance	UL, TUV, CSA, FCC, CE		
	10Base Port Specifications		
Filter/Forward Speed	14,881 pps		
Addresses/Port	4 (workgroup); 8,192 (segment)		
Buffering/Port	256 kB		
Operation	Full or half-duplex		
Connector	RJ-45 (10BaseT); ST (10BaseFL)		
Media	UTP Category 5 copper; 62.5/125μ multimode fiber		
100Base Port Specifications			
Filter/Forward Speed	148,810 pps		
Addresses/Port	4 (workgroup); 8,192 (segment)		
Buffering/Port	1 Megabyte		
Operation	Full or half-duplex		
Connector	RJ-45 (TX); ST (FX)		
Media UTP Category 5 copper; 62.5/125μ multimode fiber			

1.4 ES-3810 Settings

1.4.1 Factory Default Settings (Ethernet)

The following figures represent factory default settings of the ES-3810's Ethernet ports. (Refer to the *ForeRunner ES-3810 Configuration Manual* for a description of each port parameter.)

88-3810 Interface Configur	ation	Interface D1 (10BaseT Sthernet)	
Type: MAU: Sumber:	asc-10s 10SaseT 0	Full Duplex: Loophack: Mods:	Disabled Disabled Workgroup
Link Detected: Link Polarity:		Forced Transmits: Polarity Correction:	Disabled Disabled
Beceiver: Receive Buffer:		Transmitter: Transmit Buffer:	Enabled Enabled
anier anguent:	Disabled	Granswit Smitted Packets:	Bisabled
Blocking:	Disabled	Transmit Blocked Packets:	Disabled
Receive Eccore:	Disabled	Transmit Plagged Packets:	Disabled
Multicast Promiscuous:	Disabled	Multicast Hash Opload:	Disabled
Individual Promiscuous:	Disabled		

Figure 1.2 - 10Base-T Factory Default Settings

E8-3810 Interface Configur	ration	Interface Fl (100Bas-	ePX Sthernet;
Type: MAU: Number:	880-100A 100BaseFE 24	Loopback: Mode:	Disabled Workgroup
Media Configuration: Auto	-Negotiation	In Progress	
Link Detected:	Мo	Whan Extension:	n/a
IA Domain Matching:	Disabled	Multicast Piltering:	n/a
Receiver:	Enabled	Transmitter:	Enabled
Receive Buffer:	Enabled	Transmit Buffer:	Enabled
Bniff Begment:	Disabled	Transmit Smitted Packets:	Disabled
Blocking:	Disabled	Transmit Blocked Packets:	Disabled
Receive Errors:	Disabled	Transmit Flagged Packets:	Disabled
Multicast Fromiscuous:	Disabled	Multicast Hash Upload:	Disabled
Individual Promiscuous:	Disabled		

Figure 1.3 - 100Base-T Factory Default Settings

CHAPTER 2 Setup

The following information describes the handling and installation of the *ForeRunner* ES-3810 prior to operation.

2.1 Introduction

Before installing the ES-3810, there are several important factors that must be taken into consideration, depending on the type of installation site. The following sections discuss in detail how to install a *ForeRunner* ES-3810 switch and any prerequisites to the installation.

CAUTION



It is very important to read through and understand ALL of Chapter 2 and Chapter 3 before attempting to power on the unit.

2.2 Unpacking

Upon receipt of, and before opening the ES-3810, inspect the package for any damage that might have occurred during shipping. If the package shows any signs of external damage or rough handling, notify your carrier's representative.

When unpacking the ES-3810, be sure to keep all original packing materials.



All products returned to FORE Systems, under warranty, must be packed in their original packing materials.

2.2.1 Inventorying the Unit

A complete inventory of the ES-3810 should be performed before proceeding to further sections of this manual. The ES-3810 package should include:

- One (1) ForeRunner ES-3810 Ethernet Workgroup Switch System
- Power cords¹
- · Rack-mount accessory kit (with two brackets and eight screws)
- One (1) ForeRunner ES-3810 Installation and User's Manual (this manual)
- One (1) ForeRunner ES-3810 Configuration Manual
- One (1) Console Management serial cable



If any of the following components are not present, please contact FORE Systems, Inc.

^{1.} Up to four power cords may ship with the ES-3810. Two of the power cords are for use with U.S. power, and two are for use with Europe EC power. One of each type of power cord ships with each power supply that is ordered.

2.3 Electrical Considerations

The following items should be considered when setting up the switch:

CAUTION



Consideration should be given to the connection of the equipment to the supply circuit and the effect that the overloading of circuits could have on overcurrent protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.

CAUTION



Reliable grounding of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch (i.e., use of power strips).

2.4 Installation Options

The ES-3810 is designed to be either rack-mounted or placed on the desktop. FORE Systems recommends that the maximum operating ambient temperature (T_{mra}) of the ES-3810 not exceed 40° C. Consideration must be made if an ES-3810 is to be installed in a closed or multiunit rack assembly, because the operating ambient temperature of the rack environment may be greater than the room ambient temperature.



FORE Systems recommends mounting the ES-3810 with the wiring side forward. More LEDs are visible from this view and cable dressings and attachments can be easily verified.

2.4.1 Clearance Requirements

When installing the ES-3810, both sides of the unit should be clear from any obstructions to allow air flow through the unit.

The ES-3810 is designed to be installed either as a stand-alone unit or as a rack-mount unit using two brackets and eight screws included in the accessory kit (refer to Section 2.2.1). The standard unit can be installed with either the front or back of the unit facing forward. See Table 1.1 in Chapter 1 for information about the dimensions of the ES-3810 chassis (single and dual power supply models).

2.4.2 Installing Rack-Mount Brackets

Appropriate tools (i.e., screwdrivers) are required to install the rack-mount brackets. A set of two rack-mount brackets is supplied with each ES-3810. Each bracket is secured to the chassis using two screws, attached to either the side or the bottom of the chassis, but not both.

The ES-3810 can be placed with either the front or the back of the unit facing forward. Figure 2.1 shows the installation of one of the rack-mount brackets on a single power supply ES-3810. Install one bracket at each corner of the unit as shown.

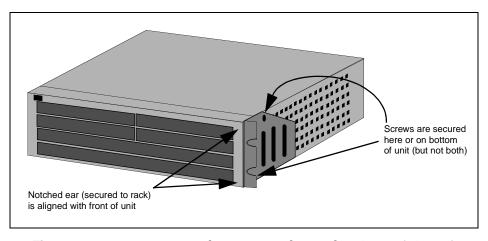


Figure 2.1 - Positioning a Rack-Mount Bracket on the ES-3810 (ES-3810)

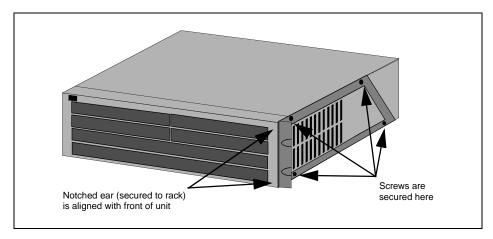


Figure 2.2 - Positioning a Rack-Mount Bracket on the ES-3810 (ES-3810/CH)

WARNING!



The use of screws other than those provided to attach the rack-mount brackets could result in damage to the unit.

2.5 Connecting the Management Station

The management console provides a menu-based user interface that utilizes a VT-100 terminal or VT-100 terminal emulator (e.g., Windows 3.x Terminal, ProComm PCPLUS). The serial interface of the ES-3810 connects directly to either the DTE interface of the ASCII terminal or a serial port of the personal computer or workstation running the terminal emulation package.

A management console should be attached when the ES-3810 is turned on so that any power-up errors may be detected. If a management station is not connected to the console port, the ES-3810 still operates using either the factory default settings detailed in Section 1.4 or the last saved settings which are restored during the power up sequence.

The ES-3810 can also be reached via Telnet. For more information about connecting to the ES-3810 via Telnet, see the *ForeRunner ES-3810 Configuration Manual*.



If the NMM's SNMP-based management or IGMP support is to be used, a console connection is required the first time the NMM is brought online since an IP address, subnet mask and possibly a gateway must be defined.

2.5.1 Connecting the Management Console Cable

The first step in the installation of the management station is to connect the included 9-pin null modem serial cable to the ES-3810. The connection interface is located on the left-hand side of the management module. Once the serial cable is secured to the ES-3810, connect the other end to either a serial port of the personal computer or workstation or the DTE interface of an ASCII terminal. The wiring information for this cable is indicated in Table 2.1.

DB9S Pin #	DB9S Pin #
1 & 6	4
2	3
3	2
4	1 & 6
5	5
7	8
8	7
9	9

Table 2.1 - Management Station Serial Cable Pinouts

2.5.2 Configuring the Management Station

Table 2.2 details the connection parameters common to most methods of terminal emulation. Please consult the respective user's manual for any unique characteristics of the emulation package you are using.

Table 2.2 - Common Connection Parameters for Terminal Emulation

Parameter	Setting
Baud	9600
Data Bits	8
Stop Bits	1
Parity	None
Flow Control	Off
Connector	COM1 or COM2

Setup

Hardware Configuration

3.1 ES-3810 Design

The ES-3810 enclosure supports a total of six modules. All six slots in the ES-3810 chassis can support half-width modules, while only slots A, B, C, and D can support full-width modules. Card guides are located on both sides of the ES-3810 enclosure to facilitate module installation by guiding a module into an available slot.

Modules "plug into" the system by mating with a connector on the system backplane. See Section 3.7 for more information about adding and removing modules.



When adding a module to the *ForeRunner* ES-3810, except in the case of an ESM-24, the individual port configurations for all ports will be returned to the factory defaults. If special port configurations have been assigned they should be noted before the module upgrade is performed. When installing an ESM-24 in a slot previously containing an ESM-24, the "last saved" configuration will be applied to the module.

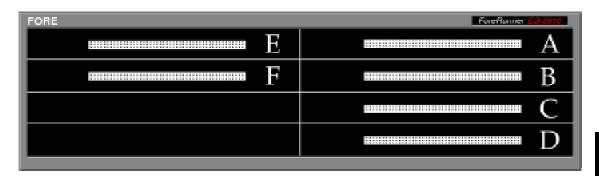


Figure 3.1 - ES-3810 Backplane: Card Slot Locations

3.2 Port Numbering

Ports are numbered in the ES-3810 according first to their slot position and second to their position relative to other ports on the same module. Ports on modules in slot A are numbered A# (where # represents the port number relative only to the module), ports on modules in slot B are numbered B#, etc.

For example, the port on an ATM uplink module in slot A is numbered port A1. Port one on a FEM-2/TX in slot F is numbered port F1. See Figure 3.2 for more examples.

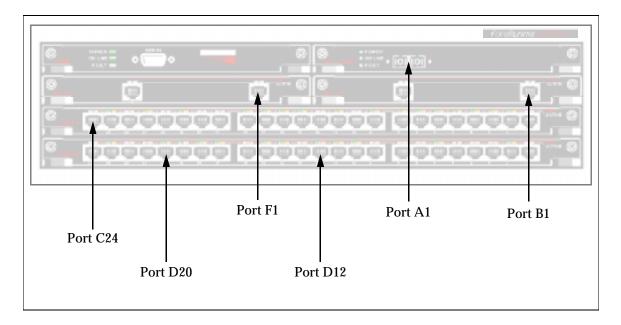


Figure 3.2 - Example of Port Numbering on the ES-3810

3.3 ES-3810 Management Modules

The minimum configuration of the ES-3810 consists of the base unit with a management processor (NMM) and 24 ports of 10 Mbps switched Ethernet. The availability of add-on modules provides flexible and scalable Ethernet switching and backbone connectivity solutions that can be customized to meet the user's needs. The following modules are available for the ES-3810.

3.3.1 NMM (Network Management Module)

The NMM, as shown in the Figure 3.3, is a half-width module. It provides both a management console and SNMP-based management.



Figure 3.3 - The Network Management Module

3.3.1.1 NMM Memory Requirements

CAUTION



Software version 4.2.0 will not operate on an NMM with 4MB of DRAM.

The NMM requires eight megabytes of DRAM to run software version 4.2.0. If you are upgrading a 4MB NMM to software version 4.2.0 or higher, the NMM's memory must be upgraded to 8MB. Instructions for performing this memory upgrade are included with the upgrade kit (NMM-UPG). Contact FORE Systems or see your distributor to obtain this upgrade kit.

3.3.1.2 NMM Status LEDs

Located on the left side of the 9-pin serial interface are three vertical status LEDs which illuminate as follows:

POWER Illuminates GREEN and signifies active POWER. If the unit is turned on and this LED does not illuminate, any of the following could apply: the NMM has blown a fuse, the power supply is damaged, the power cable is damaged, or the power cable is disconnected.

ON LINE Illuminates GREEN after applying power. Signifies that the processor has come up, basic electrical connections are functional, and the NMM has passed its power-on self-test.

FAULT Illuminates AMBER if there is a processor failure detected (i.e., the processor is likely defective). If this LED illuminates AMBER, please call FORE Systems' Technical Support.

3.3.1.3 Bandwidth Utilization Display

Located on the right side of the 9-pin serial interface of the NMM is the Bandwidth Utilization Display. This row of LEDs, as shown in Figure 3.4, indicates the volume of packets (in bps) entering and leaving the ES-3810. The NMM periodically samples the transmit and receive byte counters of each supported interface to determine the total, aggregate bandwidth being utilized. The display logarithmically indicates the moving average, over a two second period, of the total, aggregate bandwidth. The right-most LED comprising the display represents the maximum total, aggregate bandwidth the system can support. This maximum not only depends on the number and type of interfaces, but the configuration of those interfaces.

For example, consider an ES-3810 supporting two ESM-24 modules. In this system, one module is configured for half-duplex operation and the other module for full-duplex operation. This system supports a maximum, total aggregate bandwidth of $(24 \times 10 \text{ Mbps}) + (24 \times 20 \text{ Mbps})$, or 720 Mbps.

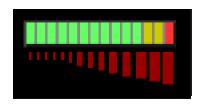


Figure 3.4 - Bandwidth Utilization Display on the NMM

Hardware Configurati

3.3.2 ESM-16 (16-port, Console Managed, Ethernet Switch Module)

The following figure depicts a console managed, 16-port, 10 Mbps module.



Figure 3.5 - The ESM-16 Module

WARNING!



DO NOT install more than one ESM-16 in an ES-3810 at any time. Each module tries to control the switch, which can cause permanent damage to both the modules and the ES-3810.



If using an ESM-16 for console management, the maximum configuration is 88 10 Mbps ports (one ESM-16 plus three ESM-24s).

3.3.2.1 ESM-16 Status LEDs

Located on the left hand side of the 9-pin serial connector, there are three vertical LEDs which illuminate as follows:

POWER Illuminates GREEN and signifies active POWER. If

the unit is turned on and this LED does not illuminate, either the power supply is damaged or the power cable is either damaged or disconnected.

ON LINE Illuminates GREEN after applying power. Signifies

that the processor has come up, basic electrical connections are functional, and the ESM-16 module

itself is recognized by the system.

FAULT Illuminates AMBER if there is a processor failure

detected (i.e., the processor is likely dead). If this LED ever comes up AMBER, please call FORE

Systems' Technical Support.

3.3.2.2 ESM-16 Port LEDs

Each port of an ESM-16 has 2 LEDs associated with it, a LINK LED and an ACTIVITY LED. These LEDs illuminate as follows:

LINK Illuminates GREEN if a valid cable is connected to

the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either bad

or crossed.

Blinks continually if the port fails initialization

diagnostics, indicating that the port is bad.

ACTIVE Illuminates AMBER and flashes to represent traffic

on the port. If the LED does not illuminate, there is

no activity on the port.

3.4 ES-3810 Workgroup Modules

3.4.1 ESM-24 (24-port, Ethernet Switch Module)

The ESM-24 module, as shown in the following figure, provides 24 ports of 10 Mbps switched Ethernet.



Figure 3.6 - The ESM-24 Module

3.4.1.1 ESM-24 Port LEDs

Each port of an ESM-24 has 2 LEDs associated with it, a LINK LED and an ACTIVITY LED. These LEDs illuminate as follows:

LINK Illuminates GREEN if a valid cable is connected to

the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either

crossed or defective.

Additionally, this LED will blink continually if the

port fails initialization diagnostics.

ACTIVE Illuminates AMBER and flashes to represent traffic

on the port. If the LED does not illuminate, there is

no activity on the port.

3.4.2 ESM-12/FL (12-port Fiber ST, Ethernet Switch Module)

The following figure shows a 10Base-FL, 12-port, full-width add-on 10 Mbps module.



Figure 3.7 - The ESM-12/FL Module

3.4.2.1 ESM-12/FL Port LEDs

Each port of an ESM-12/FL has 2 LEDs associated with it, a LINK LED and an ACTIVITY LED. These LEDs illuminate as follows:

LINK The LINK LED is above the ACTIVE LED. It illuminates GREEN if a valid cable is connected to the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either crossed or defective.

Additionally, this LED will blink continually if the port fails initialization diagnostics.

ACTIVE The ACTIVE LED is below the LINK LED. It illuminates AMBER and flashes to represent traffic on the port. If the LED does not illuminate, there is no activity on the port.

3.4.3 FEM-2/TX (2-port TX, Fast Ethernet Module)

The following figure shows a 100Base-TX two-port, half-width add-on 100 Mbps module.



Figure 3.8 - The FEM-2/TX Module

3.4.3.1 FEM-2/TX Port LEDs

Each port of an FEM-2/TX has 2 LEDs associated with it, a LINK LED and an ACTIVITY LED. These LEDs illuminate as follows:

LINK Illuminates GREEN if a valid cable is connected to the port and the endstation is powered on. If the

LINK LED does not illuminate, the cable is either

crossed or defective.

Additionally, this LED will blink continually if the

port fails initialization diagnostics.

ACTIVE Illuminates AMBER and flashes to represent traffic

on the port. If the LED does not illuminate, there is

no activity on the port.

3.4.4 FEM-2/FX (2-port FX, Fast Ethernet Module)

The following figure shows a 100Base-FX two-port, half-width add-on 100 Mbps module.



Figure 3.9 - The FEM-2/FX Module

3.4.4.1 FEM-2/FX Port LEDs

Each port of an FEM-2/FX has 2 LEDs associated with it, a LINK LED and an ACTIVITY LED. These LEDs illuminate as follows:

LINK Illuminates GREEN if a valid cable is connected to the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either crossed or defective.

Additionally, this LED will blink continually if the port fails initialization diagnostics.

ACTIVE Illuminates AMBER and flashes to represent traffic on the port. If the LED does not illuminate, there is no activity on the port.

3.4.5 FEM-8A/TX (8-port TX, Fast Ethernet Module)

The following figure shows a 10/100Base-TX, eight-port, full-width 100 Mbps module.



Figure 3.10 - The FEM-8A/TX Module

3.4.5.1 FEM-8A/TX Port LEDs

Each port of an FEM-8A/TX has 2 LEDs associated with it, a LINK LED and an ACTIVITY LED. These LEDs illuminate as follows:

LINK

Illuminates GREEN if a valid cable is connected to the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either crossed or defective.

Additionally, this LED will blink continually if the port fails initialization diagnostics.

ACTIVE

Illuminates AMBER and flashes to represent traffic on the port. If the LED does not illuminate, there is no activity on the port.

CAUTION



Installing more than two (2) FEM-8A/TX modules in an ES-3810 single-power supply chassis at any one time exceeds the power and cooling capacity of the unit.

3.5 ES-3810 Segment Modules

3.5.1 FSM-8/TX (8-port TX, Segment Switch Module)

The following figure shows a 10/100Base-TX, eight-port, full-width segment switch module.



Figure 3.11 - The FEM-8/TX Module

3.5.1.1 FSM-8/TX Processor LEDs

The FSM-8/TX has four LEDs that indicate the status of its processor: POWER, BOOT, ON LINE, and FAULT. These LEDs illuminate as follows:

POWER	Illuminates GREEN and signifies active POWER. If the unit is turned on and this LED does not illuminate, either the power supply is damaged or the power cable is either damaged or disconnected.
воот	Illuminates AMBER while the module processor is loading firmware from the NMM module after a reset or power-up.

ON LINE Illuminates GREEN after applying power and the module processor is operational. This signifies that the module is working properly.

FAULT Illuminates RED if a failure is detected. If this LED comes up RED please call FORE Support. If the LED does not illuminate, the module is OK. The LED will come on during the power-up diagnostic test.

3.5.1.2 FSM-8/TX Port LEDs

Each port of an FSM-8/TX has four LEDs associated with it: LINK, ACTIVE, DUPLEX, and SPEED. These LEDs illuminate as follows:

LINK Illuminates GREEN if a valid cable is connected to

the port and the endstation is powered on. If the LINK LED does not illuminate, the cable is either

crossed or defective.

Additionally, this LED will blink continually if the

port fails initialization diagnostics.

ACTIVE Illuminates AMBER and flashes to represent traffic

on the port. If the LED does not illuminate, there is

no activity on the port.

DUPLEX Illuminates GREEN to represent Full Duplex mode.

If the LED does not illuminate, the port is set to Half

Duplex mode.

SPEED Illuminates GREEN to represent 100 Mbps mode. If

the LED does not illuminate, the port is set to 10

Mbps mode.

CAUTION



Installing more than two (2) FSM-8/TX modules in an ES-3810 single-power supply chassis at any one time exceeds the power and cooling capacity of the unit.

3.5.2 SSM-16 (16-port, Segment Switch Module)



Figure 3.12 - The SSM-16 Module

3.5.2.1 SSM-16 Processor LEDs

The SSM-16 has four LEDs that indicate the status of its processor: POWER, BOOT, ON LINE, and FAULT. These LEDs illuminate as follows:

POWER	Illuminates GREEN and signifies active POWER. If
	the unit is turned on and this LED does not
	illuminate, either the power supply is damaged or
	the power cable is either damaged or disconnected.

BOOT	Illuminates AMBER while the module processor is
	loading firmware from the NMM module after a
	reset or power-up.

ON LINE	Illuminates GREEN after applying power and the
	module processor is operational. This signifies that
	the module is working properly.

FAULT Illuminates RED if a failure is detected. If this LED comes up RED please call FORE Support. If the LED does not illuminate, the module is OK. The LED will come on during the power-up diagnostic test.

3.5.2.2 SSM-16 Port LEDs

Each port of an SSM-16 has 2 LEDs associated with it, a LINK LED and an ACTIVITY LED. These LEDs illuminate as follows:

LINK	Illuminates GREEN if a valid cable is connected to
	the port and the endstation is powered on. If the
	LINK LED does not illuminate, the cable is either bad
	or crossed.

Blinks continually if the port fails initialization diagnostics, indicating that the port is bad.

ACTIVE Illuminates AMBER and flashes to represent traffic on the port. If the LED does not illuminate, there is no activity on the port.

Hardware Configuration

3.6 ES-3810 ATM Uplink Modules

3.6.1 ATM-1/155MMST

The following figure shows a one-port, half-width add-on 155 Mbps OC-3 Multimode ATM uplink module with ST connectors.



Figure 3.13 - The Multimode ATM Uplink Module with ST Connectors

3.6.1.1 ATM-1/155MMST LEDs

The five LEDs on the ATM-1/155MMST Module illuminate as follows:

101 17 10010110151	Wiodale mammate as follows.
POWER	Illuminates GREEN and signifies active POWER. If the unit is on and this LED does not illuminate, either the power supply or power cable are damaged, or the power cable is disconnected.
ON LINE	Illuminates GREEN after the processor has come up, basic electrical connections are functional, and the ATM uplink module itself is recognized by the system.
FAULT	Illuminates AMBER if there is a processor failure detected (i.e., the processor is likely defective). If this LED illuminates AMBER, please call FORE Systems' Technical Support.
T (transmit)	Illuminates green to indicate the transmission of data.
R (receive)	Illuminates red to indicate loss of carrier, yellow to indicate alarms and green to indicate the receipt of data.

3.6.2 ATM-1/155MMSC

The following figure shows a one-port, half-width add-on 155 Mbps OC-3 Multimode ATM uplink module with SC connectors.



Figure 3.14 - The Multimode ATM Uplink Module with SC Connectors

3.6.2.1 ATM-1/155MMSC LEDs

The five LEDs on the ATM-1/155MMSC Module illuminate as follows:

R (receive)

POWER Illuminates GREEN and signifies active POWER. If the unit is on and this LED does not illuminate, either the power supply or power cable are damaged, or the power cable is disconnected.

ON LINE Illuminates GREEN after the processor has come up, basic electrical connections are functional, and the ATM uplink module itself is recognized by the system.

FAULT Illuminates AMBER if there is a processor failure detected (i.e., the processor is likely defective). If this LED illuminates AMBER, please call FORE Systems' Technical Support.

T (transmit) Illuminates green to indicate the transmission of data.

Illuminates red to indicate loss of carrier, yellow to indicate alarms and green to indicate the receipt of data.

3.6.3 ATM-1/155SMSC

The following figure shows a one-port, half-width add-on 155 Mbps OC-3 single mode ATM uplink module with SC connectors.



Figure 3.15 - The Single Mode ATM Uplink Module with SC Connectors

3.6.3.1 ATM-1/155SMSC LEDs

The five LEDs on the ATM-1/155MMSC Module illuminate as follows:

POWER	Illuminates GREEN and signifies active POWER. If
	the unit is on and this LED does not illuminate,
	either the power supply or power cable are
	damaged, or the power cable is disconnected.

ON LINE Illuminates GREEN after the processor has come up, basic electrical connections are functional, and the ATM uplink module itself is recognized by the system.

FAULT Illuminates AMBER if there is a processor failure detected (i.e., the processor is likely defective). If this LED illuminates AMBER, please call FORE Systems' Technical Support.

T (transmit) Illuminates green to indicate the transmission of data.

R (receive) Illuminates red to indicate loss of carrier, yellow to indicate alarms and green to indicate the receipt of data.

3.6.4 ATM-1/155UTP

The following figure shows a one-port, half-width, add-on 155 Mbps ATM uplink module with a UTP connector.



Figure 3.16 - The UTP ATM Uplink Module with RJ-45 Connector

3.6.4.1 ATM-1/155UTP LEDs

The five LEDs on the ATM-1/155UTP Module illuminate as follows:

R (receive)

POWER	Illuminates GREEN and signifies active POWER. If
	the unit is on and this LED does not illuminate,
	either the power supply or power cable are
	damaged, or the power cable is disconnected.
	III ODERNI O .I

ON LINE Illuminates GREEN after the processor has come up, basic electrical connections are functional, and the ATM uplink module itself is recognized by the system.

FAULT Illuminates AMBER if there is a processor failure detected (i.e., the processor is likely defective). If this LED illuminates AMBER, please call FORE Systems' Technical Support.

T (transmit) Illuminates green to indicate the transmission of data.

Illuminates red to indicate loss of carrier, yellow to indicate alarms and green to indicate the receipt of data.

3.7 Removing and Installing Modules

The ES-3810's individual modules can be added or removed, if necessary. See the following for more detailed information.

3.7.1 Removing Full-width Modules

The steps required to remove a full-width module from the ES-3810 are as follows:

- 1. Power down the ES-3810 switch.
- 2. On the module being removed, turn the two thumbscrews to the left until they spin loosely.
- 3. Once loose, use the two ejector handles (located directly below the two thumb-screws) to remove the module.

At this point, you can insert a new module into the empty slot or leave it vacant. If you choose to insert a new module, see the instructions in Section 3.7.2. If you choose to leave the slot vacant, cover it with an appropriately sized blank bezel according to the following:

- 1. Place the blank bezel over the empty slot in the ES-3810 chassis.
- 2. Turn the two thumbscrews on either side of the bezel to the right until the bezel is completely secure over the slot.

3.7.2 Installing Full-width Modules

The steps required to install a full-width module in the ES-3810 are as follows:

- 1. Power down the ES-3810 switch.
- 2. If a blank bezel covers the slot in which the new module will reside, turn the two thumbscrews on the bezel to the left until they spin loosely.
- 3. Once loose, use the two black ejectors (located directly below the two thumb-screws) to remove the blank bezel.
- 4. Using the internal guide rails, slide the new module into the slot and push until it snaps firmly into place in the backplane.
- 5. Once in place, turn the two thumbscrews on the new module to the right until the module is completely secure in the slot.
- 6. Re-apply power to the ES-3810.



3.7.3 Disconnecting and Connecting Half-width Modules

WARNING!



Half-width modules should NEVER be installed in the ES-3810 unless securely connected to another half-width module (blank module or functional module). Attempting to install a half-width module by itself may result in damage to the ES-3810 backplane.



To install or replace an NMM, first remove any terminal connections, then follow the instructions in this section. After installing the NMM, follow the instructions in Section 2.5 for information on connecting the management station.

Half-width modules for the ES-3810 come from FORE Systems already connected to either another half-width module or a blank half-width module, forming a full-width module. All half-width modules installed in an ES-3810 are connected this way.

If you order a half-width module from FORE Systems as an add-on, it comes pre-attached to a blank half-width module. You can then install this module as if it were a full-width module. If you wish to install an add-on half-width module (e.g., an NMM) in an ES-3810 slot that already contains a half-width module (e.g., an ATM uplink), you will need to perform the following procedure:

- 1. Remove the ATM uplink (see Section 3.7.1).
- 2. Disconnect the blank half-width module from the ATM uplink (see Section 3.7.3.1).
- 3. Disconnect the blank half-width module from the NMM (see Section 3.7.3.1).
- 4. Connect the NMM and the ATM uplink (NMM on the left and ATM uplink on the right, see Section 3.7.3.2).
- 5. Install the connected NMM and ATM uplink (see Section 3.7.2).

3.7.3.1 Disconnecting Half-width Modules

You may need to disconnect two half-width modules to replace a failed module or to utilize more slots in the ES-3810 chassis. To disconnect two half-width modules, follow the steps below:

- 1. If the modules being disconnected are installed in the ES-3810, see Section 3.7.1 for information about removing a full-width module. If the modules are not installed in the ES-3810, move on to Step 2.
- 2. On the bottom side of the module being replaced (i.e., the blank module or the failed module), remove the screws that secure the module to the connecting brace.
- 3. On the front of the module being replaced, turn the thumbscrew attached to the brace connecting the modules to the left until it spins loosely.

3.7.3.2 Connecting Half-width Modules

- 1. Line up the replacement module with the module to which it is being connected.
- 2. On the front of the replacement module, turn the thumbscrew in front of the connecting brace to the right until it is tight.
- 3. On the bottom side of the replacement module, line up the holes in the module with those in the connecting brace and secure the screws removed in Section 3.7.3.1 to the brace.
- 4. Install the attached modules in the ES-3810 chassis according to the instructions in Section 3.7.2.

3.8 Power Supply Removal/Replacement

The power supplies in the ES-3810 chassis (FORE Part Number ES-3810/CH) are hot-swappable. Each supply utilizes its own power cord, allowing for separate electrical connections. With redundant power supplies installed, a single power supply failure on the ES-3810 will not cause the switch to stop functioning.

To remove or replace an ES-3810 power supply without shutting down the unit, follow the procedures in this section.

WARNING!



DO NOT attempt to add or remove a power supply that is connected to an electrical outlet. Failure to follow this warning may result in equipment damage or operator injury.

DO NOT attempt to remove/replace a power supply module without reading this section. Serious injury to the user or damage to the equipment may result if proper replacement procedures are not followed.

It is highly recommended that you use a grounding strap when handling this or any other component.

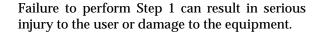


You will need a Phillips screwdriver to perform the procedures in Section 3.8.1 and Section 3.8.2.

3.8.1 Removing a Power Supply

The procedure for removing an ES-3810 power supply is as follows:

WARNING!





- 1. Flip the power switch of the supply being removed to the OFF position.
- 2. Unplug and remove the power cord from the supply being removed (remove the power cord from both the power supply and the AC source).
- 3. Remove and retain the two Phillips screws near the top of the power supply or slot cover being removed.
- 4. Turn the two thumbscrews, on the supply or cover being removed, to the left until they spin loosely (you may need to use a Phillips screwdriver to loosen the thumbscrews).
- 5. Pull on the thumbscrews to unseat the power supply or slot cover and remove it from the chassis.

3.8.2 Adding or Replacing a Power Supply

The procedure for adding an ES-3810 power supply is as follows:

WARNING!

Failure to perform Step 1 can result in serious injury to the user or damage to the equipment.



- 1. Remove the old supply or slot cover according to the instructions in Section 3.8.1.
- 2. Carefully align the new power supply in the empty slot and push on the center of its faceplate to slide it back into the enclosure.
- 3. Press firmly to seat the power supply and tighten the two thumbscrews to secure it in the chassis.
- 4. To ensure maximum safety and to ensure that the connectors have been seated properly, tighten the two thumbscrews using a Phillips screwdriver.
- 5. Insert and tighten the two Phillips screws in the holes near the top of the power supply.
- 6. Connect the power cord to the new supply in the ES-3810 chassis and plug the cord into an approved electrical outlet.
- 7. Flip the power switch on the new supply to the ON position.

Hardware configuration

3.9 Applying Power to the ES-3810

WARNING!



Ensure the following have been performed before applying power to the ES-3810.

- 1. Thoroughly read and understand Chapter 2 and Chapter 3.
- 2. Visually inspect the ES-3810, its packaging, and the contents of the accessory kit for damage (see Section 2.2.1).
- 3. Attach a management console (see Section 2.5).
- 4. Install all desired modules in the ES-3810 chassis (see Section 3.7).
- 5. Understand port characteristics and the effects of modifying them (see the *Fore-Runner ES-3810 Configuration Manual*).

Once the above steps have been completed, attach the included power cord(s) to the rear of the ES-3810, plug the other end of the cord(s) into an approved electrical outlet, and turn the power switch(es) to the ON position (see Figure 3.17).

The power connection and ON/OFF switch are located on the left rear of the single-power supply ES-3810 chassis (see Figure 3.17). On the new ES-3810 chassis (ES-3810/CH), the power connection and ON/OFF switch are located on the individual power supplies (where the fan is located in the figure below).

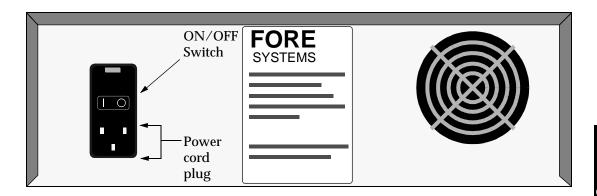


Figure 3.17 - Rear View of ES-3810

Hardware Configuration

Software Upgrade Procedures

This chapter details the procedures used to upgrade the operational software on the ES-3810. The software on the ES-3810 can be upgraded via TFTP or over the NMM's serial port.

4.1 TFTP Upgrades

This section provides information about performing a software upgrade via TFTP.



This section assumes that the ES-3810 being upgraded has already been configured with a proper IP address and subnet mask (see Chapter 5 of the *ForeRunner ES-3810 Configuration Manual*).

4.1.1 Obtaining the Software Upgrade File

You may obtain the software upgrade file from FORE Systems Technical Support. See Page ii of the *Preface* for information about contacting Technical Support.

4.1.2 Configuring the TFTP Server

After obtaining the TFTP upgrade file, place it according to the specific instructions for the TFTP server that you are using.



The TFTP server should be on the same subnet as the ES-3810 being upgraded.

4.1.3 Performing the Upgrade

After placing the upgrade file, log on to the ES-3810 and perform the steps in the following two sections (see Chapter 1 of the *ForeRunner ES-3810 Configuration Manual* for more information about logon procedures).

4.1.3.1 Selecting the Software to Upgrade

- 1. From the Main Menu, select option 1, "Manage System."
- 2. From the Manage System Menu, select option 4, "Manage Software."
- 3. Ensure that NMM System Software is displayed in the upper right corner of the Manage Software Menu. If NMM System Software appears here, move on to Section 4.1.3.2. If NMM Bootstrap Software appears here, select option 3, "Select Another Software Module."
- 4. When the Software Selection screen appears, enter the number of the option that corresponds to NMM System Software.
- 5. After returning to the Manage Software Menu, ensure that NMM System Software appears in the upper right corner of the screen and move on to Section 4.1.3.2.

4.1.3.2 Downloading the Software

- 1. From the Manage Software Menu, select option 4, "Download Software."
- 2. Carefully read the instructions that appear on the screen. Take special care to ensure the following:
 - the operational software is successfully backed up to RAM
 - the upgrade is on a TFTP on the same subnet as the ES-3810
- 3. If you are ready to perform the TFTP download, type y and press <ENTER>, otherwise enter n.
- 4. When prompted, enter the IP address of the TFTP server to which the upgrade file was copied/saved.
- 5. When prompted, enter the name of the upgrade file.
- 6. When the upgrade process begins, the DOWNLOADING... message appears.

If the download is successful, press <ENTER> when prompted and the ES-3810 will restart with the new software.

If the download fails (e.g., the upgrade file can not be found on the specified server), the current software image will be restored from RAM. Press <ENTER> to return to the Manage Software Menu.

4.2 Serial Port Upgrades

This section provides information about performing a software upgrade via the serial port.

4.2.1 Obtaining the Software Upgrade File

You may obtain the software upgrade file from FORE Systems Technical Support. See Page ii of the *Preface* for information about contacting Technical Support.

4.2.2 Configuring the Console Client

Once you have obtained the software upgrade file, ensure that you can access it from the management console, then set up your terminal emulation package to run at 38,400 bps.

CAUTION



You must use the XMODEM transfer protocol for the serial download.

The following applications have been known to perform unreliably at times for the purpose of the serial port download:

- Terminal in Windows 3.11 and NT 3.5x
- HyperTerminal in Windows 95 and NT 4.0



A serial upgrade can be performed at 9,600 bps, but it may take as long as 30 minutes.

4.2.3 Accessing the NMM's Monitor

The serial port upgrade is performed from the NMM's monitor (i.e., MON-960). Gain access to the monitor as follows:

- 1. While at the management station, power-cycle the ES-3810 (i.e., turn the power to the ES-3810 off and on again).
- 2. As soon as power is applied, continually strike the <ENTER> key until the MON-960 banner appears, as shown below:

```
Mon960 User Interface: Version 4.0.2 Jun 7 1996 NMM; for i960 CA; CA stepping number 04 Copyright 1992, 1994 Intel Corporation =>
```

4.2.4 Performing the Upgrade

To upgrade the ES-3810's operational software, follow the steps below:

1. Enter the following at the => prompt:

ef app ef cfg

The ef app command erases the portions of FLASH that contain the operational software. The ef cfg command erases the ES-3810 configuration file.



The **ef cfg** command is optional, but recommended during a software upgrade.

CAUTION



Type the following command carefully. Entering the wrong string can render the NMM inoperable.

2. Enter the following at the => prompt.

do 6fde8000

This command prepares the NMM to receive the software upgrade file.

- 3. Send the new software image to the NMM from your console client according to the specific procedures for that client.
- 4. After the download is complete, enter **rs** at the => prompt to restart the system.

The ES-3810 should restart using the new software image. If not, or if you have any problems with the upgrade, contact FORE Systems Technical Support.

The ES-3810 is designed to provide private, switched Ethernet (10 Mbps or 100 Mbps) for users in small to medium-sized workgroups. The ES-3810's ATM uplink lets the workgroup extend (using LANE 1.0) into an ATM network where high-performance servers and routers reside.

This chapter provides information about designing a network architecture using the ES-3810, including examples of some of the more common network designs. Additionally, this chapter provides information about assigning VLAN membership, IP Multicast Filtering (alternatively called Internet Group Multicast Protocol, or IGMP), and managing the ES-3810 via IP.

A.1 VLAN Assignment

VLANs are OSI Layer 2 (Data Link) multicast domains. VLAN membership is not necessarily tied to physical proximity—other criteria may apply. The ES-3810 supports three criteria: MAC address-based assignment to a VLAN, port-based assignment to a VLAN, and IP Multicast Group-based assignment to a VLAN.

A.1.1 MAC Address-based and Port-based VLANs

MAC address-based VLAN assignment supersedes port-based VLAN assignment. In the example shown in Figure A.1, MAC address 22-22-22-22 has been assigned to VLAN "Sales," but is currently connected to a port with a port level assignment to VLAN "Default." MAC address 22-22-22-22-22 would only be able to broadcast to VLAN "Sales." The ES-3810 would forward broadcasts for both VLAN "Sales" and VLAN "Default" from the port.

By adding an ATM Module, you can extend any VLAN into ATM by assigning a LEC (LAN Emulation Client) instance to the VLAN. In the following example, notice that VLANs "Default," "Marketing," and "Engineering" use port-based VLAN assignment and are extended into ATM (LEC 1, 2, and 3).

The VLAN "Sales" has both port-based and MAC address-based VLAN members, but has NOT been extended into ATM (no LEC). The station with MAC address 22-22-22-22-22 cannot send or receive broadcasts through the ATM interface.

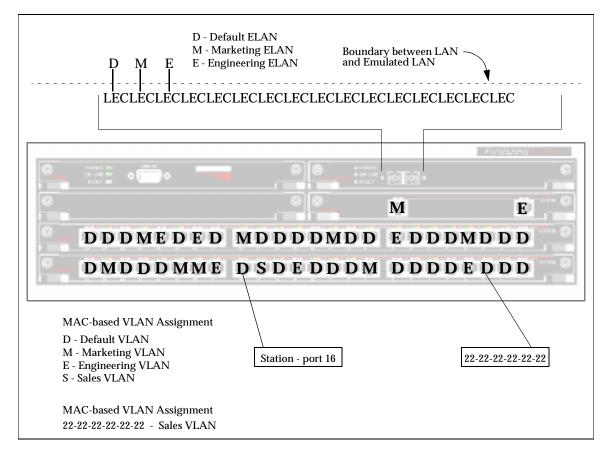


Figure A.1 - MAC and Port-based VLANs



A VLAN extended into ATM must be named with the same NAME and CASE as the ELAN. For example, an ELAN called "Engineering," exists and you want the station on ES-3810 port 16 to join it. On the ES-3810, you must create a VLAN called "Engineering" (not "engineering"), and assign port 16 to it. When asked to "configure a LEC," say yes. The ES-3810 will join (in proxy) the ELAN called "Engineering" and allow the station on port 16 to communicate with it.

A.1.2 IGMP-based VLANs

Some TCP/IP applications use IP multicasts to deliver data to many stations at once. However, multicasting can cause problems because stations that are not interested in receiving the multicast data see it anyway. This causes Ethernet segment congestion and unnecessary interrupts on workstations. Filtering these multicasts via IGMP can reduce this congestion and keep network traffic moving.

When creating a VLAN on the ES-3810, either by port-based or MAC address-based criteria, you are prompted to enable or disable IP Multicast Filtering (IGMP) support. If you disable this function, all IP multicasts coming into a VLAN are flooded to all ports and MAC addresses in that VLAN.

If you enable IGMP, flooding of IP multicasts is disabled. The ES-3810 snoops IP multicast frames to determine which ports and which MAC addresses are joining and leaving groups. The ES-3810 only forwards a specific IP multicast group's traffic out a specific port (or to a MAC address) that wishes to join that specific IP multicast group.

Once a station issues a multicast leave command for a specific multicast group, the ES-3810 stops forwarding multicast traffic for that group out that port. The ES-3810 can support up to 50 IP multicast groups per VLAN. See Figure A.2 for an example of how IGMP works.



An IP address must be assigned to the NMM for IGMP to work.

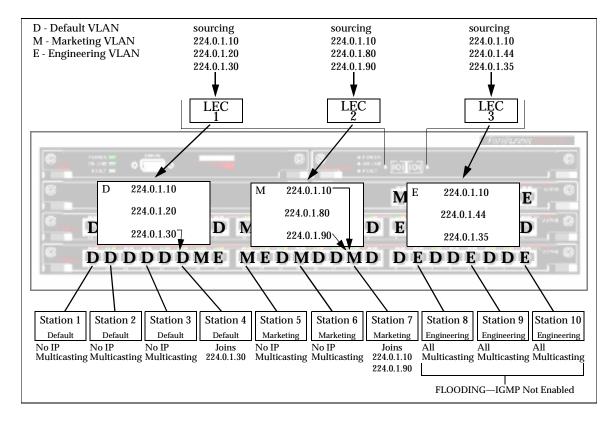


Figure A.2 - Example of IGMP



IGMP is designed to add further granularity within a VLAN. If a station from two separate VLANS join the same IP multicast group, the IP multicast stream has to be sourced twice, once within each VLAN.

The IP client of the ES-3810 is reachable from the first configured VLAN, independent of that VLAN's name. Since, by default, the first VLAN is called "default," that is where the IP client is reachable. If the first VLAN is made to be called "Sales," and "default" is now further down in the list, the IP client would still be in "Sales," the first configured VLAN.

A.2 Network Design Alternatives

This section details several network design alternatives in which the ES-3810 can be utilized.

A.2.1 Routerless Network

A routerless network is one in which the ES-3810 switches Ethernet-attached hosts to ATM where high-speed servers are found. Typically, one or several of the following network scenarios applies:

- Network has no VLAN-to-VLAN traffic requirement
- Primary network OS is Client/Server-based
- · Security is a major concern
- Servers are on ATM for maximum performance

Any network matching one or more of the above scenarios would benefit from a routerless design, because clients from different VLANs can access the same server, but not other VLANs.

This network design option is made possible because *ForeRunner* ATM adapters and LAN access devices support multiple LEC instances. Designing the network along this method (no inter-VLAN communication between clients) reduces the size of broadcast domains and reduces the need for routers on the network. See Figure A.3 for an example of this network design.

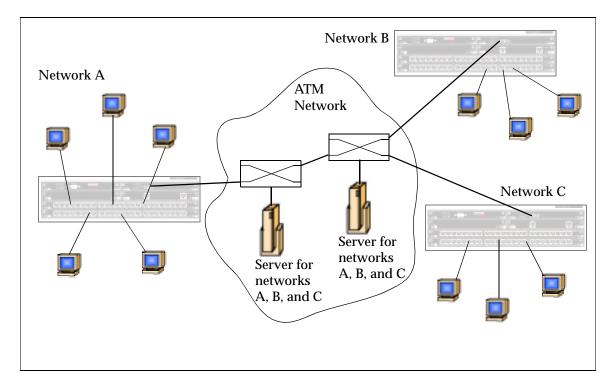


Figure A.3 - Routerless Network Design

In Figure A.3, three emulated Ethernet LANs exist (i.e., three LES/BUS pairs and 1 LECS configured in the ATM domain). Each ES-3810 joins only one (one LEC enabled) emulated LAN while each server joins all three (3 LEC instances).

A different IPX network number exists in each emulated LAN (the servers are configured with a unique network number to each LEC instance), but no router exists (i.e., communication is not possible between the different IPX networks). Broadcast domains are kept small, and all network servers can be reached via switching.



In this example, each ES-3810 joins only one emulated LAN. Using Port and MAC address-based VLAN assignment, an ES-3810 can join up to 16 different ELANs.

A.2.2 Centralized Routing Network

A centralized routing network is one in which the ES-3810 switches Ethernet-attached hosts to ATM where high-speed servers and router interfaces are found. Typically, the ES-3810 can be utilized in a network that meets one or more of the following criteria:

- Maintenance of a relatively flat network.
- Some VLAN to VLAN communication required (bridging/routing).
- Some VLAN to VLAN packet level filtering/firewalling required.
- Traffic is 80% local, 20% routed.
- Network has grown over time by adding routers, leading to an extremely subnetted network that adds little value. This network could collapse into fewer subnets by switching to ATM.
- Desire for fastest connectivity into major ATM servers.

See Figure A.4 for an example of the a centrally routed network that uses IP.

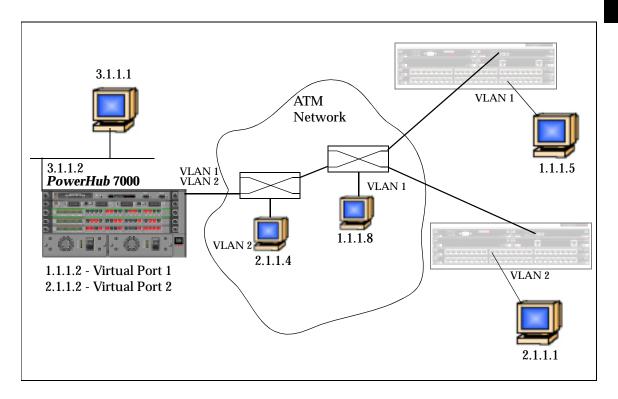


Figure A.4 - Centralized Routing Network Design

In Figure A.4, the *PowerHub* 7000 is acting as a "virtual router" between the 2.0.0.0 (VLAN 2) and 1.0.0.0 (VLAN 1) networks. This design works best when the majority of communication in the network is 80% local and 20% routed.

Low cost LAN access devices (i.e., the ES-3810) with low latency switching can be used at the edge for connecting to high-speed servers and high-speed router interfaces. In this network, two LES/BUS pairs and one LECS exist within the ATM domain. The *PowerHub* 7000 "virtual router" has two LEC instances configured—one attached to each Emulated LAN.

This model works best when the majority of LAN segments are one access device "hop" away from the ATM domain, where a low latency path to ATM servers is critical but VLAN-to-VLAN communication is also necessary. In this model, filtering and firewalling can be applied at the *PowerHub* 7000.



These basic models—Routerless and Centralized Routing—can be combined to meet many LAN design requirements.

A.2.3 VLAN Extension over ATM

A VLAN can be extended across ATM using LANE 1.0. Many LANE instances can exist in the same ATM domain (the ES-3810 can join up to 16 concurrently). The LES/BUS services allow multiple entry points into a broadcast domain.

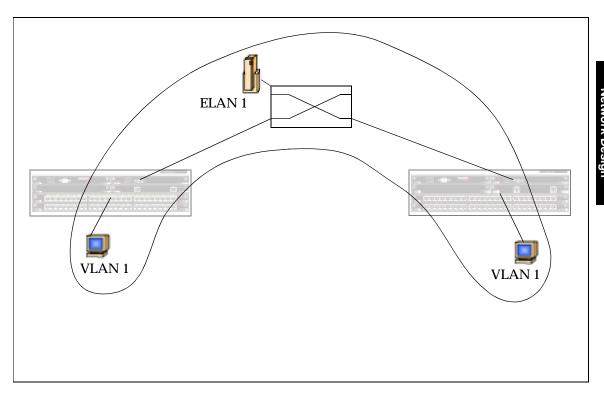


Figure A.5 - Extending a VLAN over ATM

A.2.4 VLAN Extension over Fast Ethernet

A VLAN can be extended across 100Base Ethernet using VLAN tagging. The 100Base ports on the ES-3810 support a tagging function which allows ES-3810 units to be attached to each other sequentially. Up to 16 VLANs can exist among all ES-3810 units attached in this way.

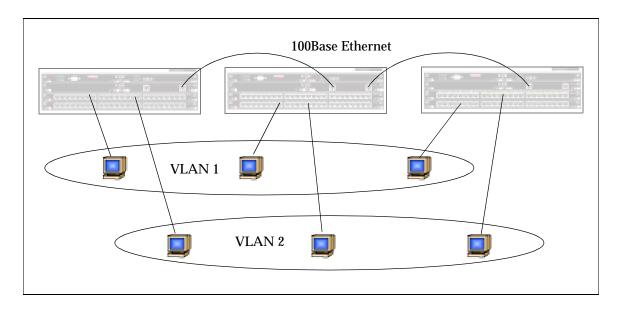


Figure A.6 - Extending a VLAN over Fast Ethernet



In order to configure the above network, the 100Base ports must be configured for Backbone with Tagging.



The ES-3810 does not support Spanning Tree in this software release. DO NOT use both the ATM uplink technique and the 100Base at the same time.

A.3 Typical Configurations

The following sections detail some typical network/workgroup scenarios in which the ES-3810 can be utilized.

A.3.1 10 Mbps Ethernet Workgroup

The most basic use of the ES-3810 is to give dedicated 10 Mbps to the desktop for a high-performance workgroup of up to 72 Ethernet users (assuming in-band management), as shown in Figure A.7.

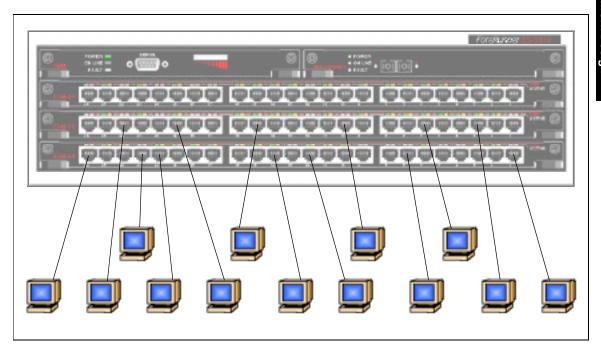


Figure A.7 - Example of a 10 Mbps Ethernet Workgroup

A.3.2 100 Mbps Ethernet Workgroup

The ES-3810 can support a high-speed workgroup of up to ten 100 Mbps stations, as shown in Figure A.8.

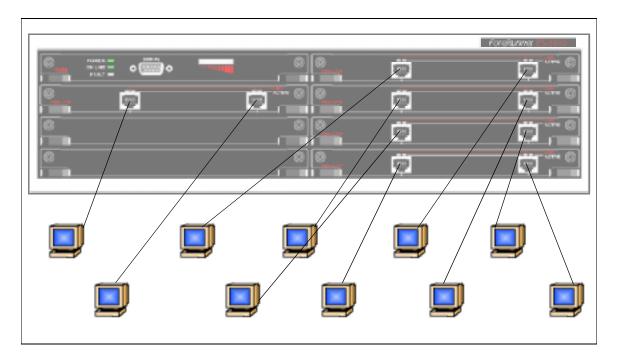


Figure A.8 - Example of a 100 Mbps Ethernet Workgroup

A.3.3 10 and 100 Mbps Ethernet Workgroup

The ES-3810 lets users combine 10 and 100 Mbps ports. This is popular for 10 Mbps to the desktop with servers on 100 Mbps Ethernet, as shown in Figure A.9.

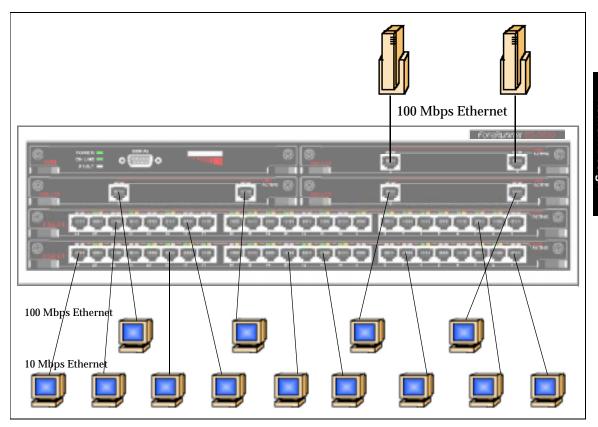


Figure A.9 - Example of a 10 Mbps and 100 Mbps Ethernet Workgroup

A.3.4 10 and 100 Mbps Ethernet Workgroup with ATM

A 10 and 100 Mbps workgroup can be linked to an ATM network. The combination of 10 Mbps to the desktop, 100 Mbps to local workgroup servers, and an ATM uplink into a LANE network in which corporate servers and router interfaces reside is an efficient and cost-effective solution.

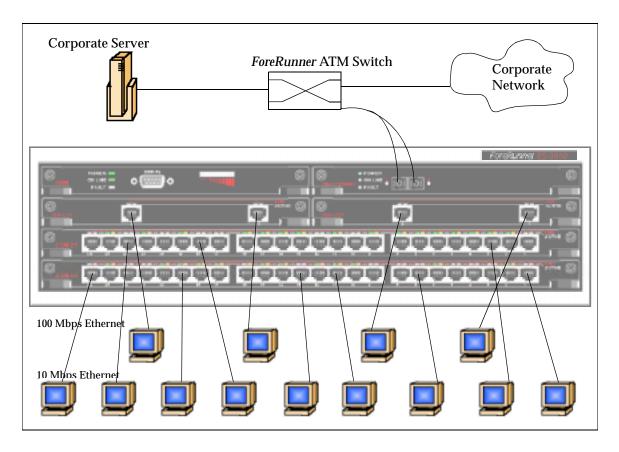


Figure A.10 - Example of a 10 Mbps and 100 Mbps Ethernet Workgroup Connected to ATM

Acronyms

The networking terms in the following list are defined in the Glossary of this manual. Glossary items are listed alphabetically according to the full term.

AAL ATM Adaptation Layer
ABR Available Bit Rate

ACM Address Complete Message

ACR Allowable Cell Rate

ADPCM Adaptive Differential Pulse Code Modulation

AHFG ATM-attached Host Functional Group

AIMUX ATM Inverse Multiplexing
AIS Alarm Indication Signal
AMI Alternate Mark Inversion
AMI ATM Management Interface

ANSI American National Standards Institute
APCM Adaptive Pulse Code Modulation
API Application Program Interface

APP Application Program

APS Automatic Protection Switching
ARP Address Resolution Protocol

ASCII American Standard Code for Information Interchange

ATDM Asynchronous Time Division Multiplexing

ATM Asynchronous Transfer Mode
AUI Attachment User Interface
BBZS Bipolar 8 Zero Substitution

BCOB Broadband Connection Oriented Bearer

BCOB-A Bearer Class A
BCOB-C Bearer Class C
BCOB-X Bearer Class X

BECN Backward Explicit Congestion Notification

BER Bit Error Rate

BES Bursty Errored SecondsBGP Border Gateway ProtocolB-ISDN Inter-Carrier Interface.

BIP Bit Interleaved Parity

B-ISDN Broadband Integrated Services Digital Network

B-ISUP Broadband ISDN User's Part

Acronyms

BITS Building Integrated Timing Supply

BNC Bayonet-Neill-Concelman
BPDU Bridge Protocol Data Unit

bps Bits per SecondBPV Bipolar Violation

B-TE Broadband Terminal Equipment
BUS Broadcast and Unknown Server
CAC Connection Admission Control
CAS Channel Associated Signaling

CBDS Connectionless Broadband Data Service

CBR Constant Bit Rate

CCITT International Telephone and Telegraph Consultative Committee

CCS Common Channel Signaling

CDV Cell Delay Variation
CE Connection Endpoint

CEI Connection Endpoint Identifier
CES Circuit Emulation Service
CGA Carrier Group Alarm

CIP Carrier Identification Parameter
CIR Committed Information Rate

CLIP Classical IP
CLP Cell Loss Priority
CLR Cell Loss Ratio-1-15
CLS Connectionless service

CMIP Common Management Interface Protocol

CMR Cell Misinsertion Rate

CPE Customer Premise Equipment

CRA Cell Rate Adaptation
CRC Cyclic Redundancy Check

CRS Cell Relay Service
CS Controlled Slip, or

Convergence Sublayer Channel Service Unit

CSU Channel Service Un
CTD Cell Transfer Delay
CTS Clear To Send

DACS Digital Access and Cross-Connect System
DARPA Defense Advanced Research Projects Agency

DCC Data Country Code

DCE Data Communications Equipment
DCS Digital Cross-connect System
DES Destination End Station

DFA DXI Frame Address

DLCI Data Link Connection Identifier

DNS Domain Naming System

DSn Digital Standard n (n=0, 1, 1C, 2, and 3)

DSR Data Set Ready

DTE Data Terminal Equipment
DTR Data Terminal Ready

EEPROM Electrically Erasable Programmable Read Only Memory

EFCI Explicit Forward Congestion Indication

EGP Exterior Gateway Protocol

EIA Electronics Industries Association

EISA Extended Industry Standard Architecture

ELAN Emulated Local Area Network Electromagnetic Interference

EPROM Erasable Programmable Read Only Memory

EQL Equalization

ER Explicit Rate

ES End System, or

Errored Second

ESF Extended Super Frame **ESI** End System Identifier

EXZ Excessive Zeroes (Error Event)

FC Face Contact

FCC Federal Communications Commission

FCS Frame Check Sequence

FDDI Fiber Distributed Data Interface
FDM Frequency Division Multiplexing

FEBE Far End Block Error FEC Forward Error Correction

FECN Forward Explicit Congestion Notification

FERF Far End Receive Failure
FIFO First-In, First-Out
FRS Frame-Relay Service
FTP File Transfer Protocol
FT-PNNI ForeThought PNNI
FUNI Frame-Based UNI

GCAC Generic Connection Admission Control

GCRA Generic Cell Rate Algorithm

GFC Generic Flow Control HDB3 High Density Bipolar

HDLC High Level Data Link Control

HEC Header Error Control

HIPPI High Performance Parallel Interface

HSSI High-Speed Serial Interface

ICMP Internet Control Message Protocol

Acronyms

IDU Interface Data Unit

IEEE Institute of Electrical and Electronics Engineers

IETF Internet Engineering Task Force
ILMI Interim Local Management Interface

IP Internet Protocol

IPX Internetwork Packet Exchange

IS Intermediate system

ISDN Integrated Services Digital Network ISO International Standards Organization

ITU-T International Telecommunication Union Telecommunication

IWF Interworking Function IXC Interexchange Carriers

JPEG Joint Photographic Experts Group

Kbps Kilobits per second
LAN Local Area Network
LANE LAN Emulation

LAPB Link Access Procedure, Balanced Local Access and Transport Area

LEO Line Build Out
LCV Line Code Violations

LE_ARP LAN Emulation Address Resolution Protocol

LEC LAN Emulation Client

LECS LAN Emulation Configuration Server

LES LAN Emulation Server
LLC Logical Link Control
LOF Loss Of Frame
LOP Loss Of Pointer

LOS Loss Of Signal
LSB Least Significant Bit
MAC Media Access Control
MAN Metropolitan Area Network
MAU Media Attachment Unit
MBS Maximum Burst Size

MCDV Maximum Cell Delay Variance
MCLR Maximum Cell Loss Ratio

MCR Minimum Cell Rate

MCTDMaximum Cell Transfer DelayMIBManagement Information BaseMICMedia Interface Connector

MID Message Identifier

MMF Multimode Fiber Optic Cable
MPEG Motion Picture Experts Group
MPOA Multiprotocol over ATM

MSB Most Significant Bit

MTU Maximum Transmission Unit
NM Network Management Entity
NML Network Management Layer
NMS Network Management Station

NNI Network-to-Network Interface or Network Node Interface

NPC Network Parameter Control

NRZ Non Return to Zero

NRZI Non Return to Zero Inverted
NSAP Network Service Access Point
NTSC National TV Standards Committee
OAM Operation and Maintenance Cell

OC-n Optical Carrier level-n
OID Object Identifier
OOF Out-of-Frame

OSI Open Systems Interconnection
OSPF Open Shortest Path First Protocol
OUI Organizationally Unique Identifier
PAD Packet Assembler Disassembler

PAL Phase Alternate Line
PBX Private Branch Exchange

PCI Peripheral Component Interconnect

PCM Pulse Code Modulation

PCR Peak Cell Rate

PDN Public Data Network
PDU Protocol Data Unit
PHY Physical Layer

ping Packet Internet Groper

PLCP Physical Layer Convergence Protocol

PLP Packet Level Protocol
PM Physical Medium

PMD Physical Medium Dependent

PNNI Private Network Node Interface or Private Network-to-Network Interface

PPP Point-to-Point Protocol

PROM Programmable Read-Only Memory

PRS Primary Reference Source
PSN Packet Switched Network

PT Payload Type

PVC Permanent Virtual Circuit (or Channel)
PVCC Permanent Virtual Channel Connection
PVPC Permanent Virtual Path Connection

QD Queuing Delay
QoS Quality of Service

Acronyms

RD Routing Domain
RFCs Requests For Comment
RFI Radio Frequency Interference
RIP Routing Information Protocol
RISC Reduced Instruction Set Computer

RTS Request To Send
SA Source Address
SA Source MAC Address
SAP Service Access Point

SAR Segmentation And Reassembly

SC Structured Cabling, or

Structured Connectors, or

Stick and Click

SCR Sustainable Cell Rate

SCSI Small Computer Systems Interface
SDLC Synchronous Data Link Control

SDU Service Data Unit

SEAL Simple and Efficient Adaptation Layer
SECAM Systeme En Coleur Avec Memoire

SEL Selector

SES Severely Errored Seconds

SF Super Frame

SGMP Simple Gateway Management Protocol

SIR Sustained Information Rate

SLIP Serial Line IP

SMDS Switched Multimegabit Data Service

SMF Single Mode Fiber

SMTP Simple Mail Transfer Protocol
SNA Systems Network Architecture
SNAP SubNetwork Access Protocol
SNI Subscriber Network Interface

SNMP Simple Network Management Protocol

SONET Synchronous Optical Network

SPANS Simple Protocol for ATM Network Signalling

SPARC Scalable Processor Architecture Reduced instruction set Computer

SPE Synchronous Payload Envelope

SPVC Smart PVC

SS7 Signaling System No. 7

SSCOP Service Specific Connection Oriented Protocol

SSCS Service Specific Convergence Sublayer

ST Straight Tip, or

Stick and Turn

STM Synchronous Transfer Mode

STP Shielded Twisted Pair, Spanning Tree Protocol

STS Synchronous Transport Signal

SVC Switched Virtual Circuit (or Channel)
SVCC Switched Virtual Channel Connection
SVPC Switched Virtual Path Connection

TAXI Transparent Asynchronous Transmitter/Receiver Interface

TC Transmission Convergence
TCP Transmission Control Protocol

TCP/IP Transmission Control Protocol/Internet Protocol

TCR Tagged Cell Rate

TCS Transmission Convergence Sublayer

TDM Time Division Multiplexing

TE Terminal Equipment

TFTP Trivial File Transfer Protocol

TM Traffic Management
UAS Unavailable Seconds
UBR Unspecified Bit Rate
UDP User Datagram Protocol
UNI User-to-Network Interface
UPC Usage Parameter Control

UTOPIA Universal Test & Operations Interface for ATM

UTP Unshielded Twisted Pair

VBR Variable Bit Rate

VC Virtual Channel (or Circuit)
VCC Virtual Channel Connection
VCI Virtual Channel Identifier
VCL Virtual Channel Link
VINES Virtual Network Software
VLAN Virtual Local Area Network

VP Virtual Path

VPC Virtual Path Connection
VPDN Virtual Private Data Network

VPI Virtual Path Identifier
VPL Virtual Path Link
VPN Virtual Private Network
VPT Virtual Path Terminator

VS/VD Virtual Source/Virtual Destination

VT Virtual Tributary
WAN Wide-Area Network

ZBTSI Zero Byte Time Slot Interchange

Acronyms

Glossary

802.1d Spanning Tree Bridging - the IEEE standard for bridging; a MAC layer standard for transparently connecting two or more LANs (often called subnetworks) that are running the same protocols and cabling. This arrangement creates an extended network, in which any two workstations on the linked LANs can share data.

802.3 Ethernet - the IEEE standard for Ethernet; a physical-layer standard that uses the CSMA/CD access method on a bus-topology LAN.

802.5 Token Ring - the IEEE physical-layer standard that uses the token-passing access method on a ring-topology LAN.

AAL (ATM Adaptation Layer) - the AAL divides the user information into segments suitable for packaging into a series of ATM cells. There are several types of AALs in use. FORE Systems currently supports AAL 5 and AAL 3/4. AAL 3/4 supports connection-oriented VBR data transfer and connectionless VBR data transfer, respectively. AAL 5 is defined as Simple and Efficient Adaptation Layer (SEAL).

AAL Connection - an association established by the AAL between two or more next higher layer entities.

ABR (Available Bit Rate) - a type of traffic for which the ATM network attempts to meet that traffic's bandwidth requirements. It does not guarantee a specific amount of bandwidth and the end station must retransmit any information that did not reach the far end.

ACR (Allowable Cell Rate) - parameter defined by the ATM Forum for ATM traffic management. ACR varies between the MCR and the PCR, and is dynamically controlled using congestion control mechanisms.

Address Mask - a bit mask used to identify which bits in an address (usually an IP address) are network significant, subnet significant, and host significant portions of the complete address. This mask is also known as the subnet mask because the subnetwork portion of the address can be determined by comparing the binary version of the mask to an IP address in that subnet. The mask holds the same number of bits as the protocol address it references.

Agent (SNMP) - a component of network- and desktop-management software, such as SNMP, that gathers information from MIBs.

AIS (Alarm Indication Signal) - a line AIS is asserted when a 111 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. A line AIS is removed when any pattern other than 111 is detected in these bits for five consecutive frames.

alarm - an unsolicited message from a device, typically indicating a problem with the system that requires attention.

AMI (ATM Management Interface) - the user interface to FORE Systems' *ForeThought* switch control software (SCS). AMI lets users monitor and change various operating configurations of FORE Systems switches and network module hardware and software, IP connectivity, and SNMP network management.

ANSI (American National Standards Institute) - a private organization that coordinates the setting and approval of some U.S. standards. It also represents the United States to the International Standards Organization.

API (Application Program Interface) - a language format that defines how a program can be made to interact with another program, service, or other software; it allows users to develop custom interfaces with FORE products.

APP (application program) - a complete, self-contained program that performs a specific function directly for the user.

AppleTalk - a networking protocol developed by Apple Computer for communication between Apple's products and other computers. Independent of the network layer, AppleTalk runs on LocalTalk, EtherTalk and TokenTalk.

ARP (Address Resolution Protocol) - a method used to resolve higher level protocol addressing (such as IP) into the appropriate header data required for ATM; i.e., port, VPI, and VCI; also defines the AAL type to be used.

ASCII (American Standard Code for Information Interchange) - a standard character set that (typically) assigns a 7-bit sequence to each letter, number, and selected control characters.

Assigned Cell - a cell that provides a service to an upper layer entity or ATM Layer Management entity (ATMM-entity).

asxmon - a FORE program that repeatedly displays the state of the switch and of all its active ports.

ATDM (Asynchronous Time Division Multiplexing) - a method of sending information that resembles normal TDM, except that time slots are allocated as needed rather than preassigned to specific transmitters.

ATM (Asynchronous Transfer Mode) - a transfer mode in which the information is organized into cells. It is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic.

ATM Forum - an international non-profit organization formed with the objective of accelerating the use of ATM products and services through a rapid convergence of interoperability specifications. In addition, the Forum promotes industry cooperation and awareness.

ATM Layer link - a section of an ATM Layer connection between two adjacent active ATM Layer entities (ATM-entities).

ATM Link - a virtual path link (VPL) or a virtual channel link (VCL).

ATM Peer-to-Peer Connection - a virtual channel connection (VCC) or a virtual path connection (VPC) directly established, such as workstation-to-workstation. This setup is not commonly used in networks.

ATM Traffic Descriptor - a generic list of parameters that can be used to capture the intrinsic traffic characteristics of a requested ATM connection.

ATM User-to-User Connection - an association established by the ATM Layer to support communication between two or more ATM service users (i.e., between two or more next higher layer entities or between two or more ATM entities). The communication over an ATM Layer connection may be either bidirectional or unidirectional. The same Virtual Channel Identifier (VCI) is used for both directions of a connection at an interface.

atmarp - a FORE program that shows and manipulates ATM ARP entries maintained by the given device driver. This is also used to establish PVC connections.

atmconfig - a FORE program used to enable or disable SPANS signalling.

atmstat - a FORE program that shows statistics gathered about a given adapter card by the device driver. These statistics include ATM layer and ATM adaptation layer cell and error counts. This can also be used to query other hosts via SNMP.

AUI (Attachment User Interface) - IEEE 802.3 interface between a media attachment unit (MAU) and a network interface card (NIC). The term AUI can also refer to the rear panel port to which an AUI cable might attach.

Auto-logout - a feature that automatically logs out a user if there has been no user interface activity for a specified length of time.

B8ZS (Bipolar 8 Zero Substitution) - a line coding technique used to accommodate the ones density requirements of T1 facilities.

Backbone - the main connectivity device of a distributed system. All systems that have connectivity to the backbone connect to each other. This does not stop systems from setting up private arrangements with each other to bypass the backbone for cost, performance, or security.

Bandwidth - usually identifies the capacity or amount of data that can be sent through a given circuit; may be user-specified in a PVC.

baud - unit of signalling speed. The speed in baud is the number of discrete conditions or signal events per second. If each signal event represents only one bit, the baud rate is the same as bps; if each signal event represents more than one bit (such as a dibit), the baud rate is smaller than bps.

BECN (Backward Explicit Congestion Notification) - bit set by a Frame Relay network in frames traveling in the opposite direction of frames encountering a congested path. Data terminal equipment (DTE) receiving frames with the BECN bit set can request that higher-level protocols take flow control action as appropriate. Compare with *FECN*.

BES (Bursty Errored Seconds) - a BES contains more than 1 and fewer than 320 path coding violation error events, and no severely errored frame or AIS defects. Controlled slips are not included in determining BESs.

BGP (Border Gateway Protocol) - used by gateways in an internet connecting autonomous networks. It is derived from experiences learned using the EGP.

BIP (Bit Interleaved Parity) - an error-detection technique in which character bit patterns are forced into parity, so that the total number of one bits is always odd or always even. This is accomplished by the addition of a one or zero bit to each byte, as the byte is transmitted; at the other end of the transmission, the receiving device verifies the parity (odd or even) and the accuracy of the transmission.

B-ISDN (Broadband Integrated Services Digital Network) - a common digital network suitable for voice, video, and high-speed data services running at rates beginning at 155 Mbps.

BNC (Bayonet-Neill-Concelman) - a bayonet-locking connector for miniature coax.

BPDU (Bridged Protocol Data Unit) - Spanning-tree Protocol hello packet that is sent out at configurable intervals to exchange information among bridges in the network.

bps (bits per second) - a measure of speed or data rate. Often combined with metric prefixes in kbps for thousands of bits per second (k fir kilo-) and in Mbps for millions of bits per second (M for mega-).

BPV (Bipolar Violation) - an error event on a line in which the normal pattern of alternating high (one) and low (zero) signals is disrupted. A bipolar violation is noted when two high signals occur without an intervening low signal, or vice versa.

Bridge - a device that expands a Local Area Network by forwarding frames between data link layers associated with two separate cables, usually carrying a common protocol. Bridges can usually be made to filter certain packets (to forward only certain traffic).

Broadband - a service or system requiring transmission channels capable of supporting rates greater than the Integrated Services Digital Network (ISDN) primary rate.

Broadband Access - an ISDN access capable of supporting one or more broadband services.

Brouter (bridging/router) - a device that routes some protocols and bridges others based on configuration information.

Bursty Second - a second during which there were at least the set number of BES threshold event errors but fewer than the set number of SES threshold event errors.

BUS (Broadcast and Unknown Server) - in an emulated LAN, the BUS is responsible for accepting broadcast, multicast, and unknown unicast packets from the LECs to the broadcast MAC address (FFFFFFFFFFFF) via dedicated point-to-point connections, and forwarding the packets to all of the members of the ELAN using a single point-to-multipoint connection.

CAC (Connection Admission Control) - the procedure used to decide if a request for an ATM connection can be accepted based on the attributes of both the requested connection and the existing connections.

Call - an association between two or more users or between a user and a network entity that is established by the use of network capabilities. This association may have zero or more connections.

Carrier - a company, such as any of the "baby Bell" companies, that provide network communications services, either within a local area or between local areas.

CBR (Constant Bit Rate) - a type of traffic that requires a continuous, specific amount of bandwidth over the ATM network (e.g., digital information such as video and digitized voice).

CBR port - a port on the *CellPath* 300 for transmitting and receiving CBR traffic.

cchan - a FORE program used to manage virtual channels on a FORE Systems ATM switch running asxd.

CCITT (Consultative Committee for International Telephone and Telegraph) - an international consultative committee that sets international communications recommendations, which are frequently adopted as standards; develops interface, modem, and data network recommendations. Membership includes PTTs, scientific and trade associations, and private companies. CCITT is part of the International Communications Union (a United nations treaty organization in Geneva).

CDV (**Cell Delay Variation**) - a quantification of cell clumping for a connection. The cell clumping CDV (yk) is defined as the difference between a cell's expected reference arrival time (ck) and its actual arrival time (ak). The expected reference arrival time (ck) of cell k of a specific connection is max $[c_{\{k-1\}} + T, a_k]$. T is the reciprocal of the negotiated peak cell rate.

CE (Connection Endpoint) - a terminator at one end of a layer connection within a SAP.

CEI (Connection Endpoint Identifier) - an identifier of a CE that can be used to identify the connection at a SAP.

Cell - an ATM Layer protocol data unit (PDU). The basic unit of information transported in ATM technology, each 53-byte cell contains a 5-byte header and a 48-byte payload.

Cell Delineation - the protocol for recognizing the beginning and end of ATM cells within the raw serial bit stream.

Cell Header - ATM Layer protocol control information.

Cell Port - a port on the *CellPath* 300 that transmits and receives traffic in cell format.

Cell Rate Adaptation - a function performed by a protocol module in which empty cells (known as unassigned cells) are added to the output stream. This is because there always must be a fixed number of cells in the output direction; when there are not enough cells to transmit, unassigned cells are added to the output data stream.

Cell Transfer Delay - the transit delay of an ATM cell successfully passed between two designated boundaries.

CES (Circuit emulation Services) - The *CellPath* 90 supports Circuit Emulation Services (CES) for applications requiring a fixed delay, lossless end-to-end connection through the network. In essence, CES provides a virtual private line service to the connecting application.

Channelization - capability of transmitting independent signals together over a cable while still maintaining their separate identity for later separation.

CLP (Cell Loss Priority) - the last bit of byte four in an ATM cell header; indicates the eligibility of the cell for discard by the network under congested conditions. If the bit is set to 1, the cell may be discarded by the network depending on traffic conditions.

Cold Start Trap - a *CellPath* 300 SNMP trap which is sent when the unit has been power-cycled (*see* trap).

Comm Port - the front panel DCE port that allows access to the *CellPath* 300 user interface via a connected terminal.

Concentrator - a communications device that offers the ability to concentrate many lower-speed channels into and out of one or more high-speed channels.

Congestion Management - a *CellPath* 300 feature that helps ensure reasonable service for VBR connections in an ATM network. For each connection, the *CellPath* 300 maintains a priority, sustained cell rate (SCR), and peak cell rate (PCR). During times of congestion, the *CellPath* 300 reduces the bandwidth to the SCR, based on the priority of the connection.

Connection - the concatenation of ATM Layer links in order to provide an end-to-end information transfer capability to access points.

Connectionless Service - a type of service in which no pre-determined path or link has been established for transfer of information, supported by AAL 4.

Connection-Oriented Service - a type of service in which information always traverses the same pre-established path or link between two points, supported by AAL 3.

Controlled Slip - a situation in which one frame's worth of data is either lost or replicated. A controlled slip typically occurs when the sending device and receiving device are not using the same clock.

Corresponding Entities - peer entities with a lower layer connection among them.

cpath - a FORE program used to manage virtual paths on a FORE Systems ATM switch running asxd.

CPE (Customer Premise Equipment) - equipment that is on the customer side of the point of demarcation, as opposed to equipment that is on a carrier side. *See also* point of demarcation.

cport - a FORE program used to monitor and change the state of ports on a FORE Systems ATM switch running asxd.

CRC (Cyclic Redundancy Check) - an error detection scheme in which a number is derived from the data that will be transmitted. By recalculating the CRC at the remote end and comparing it to the value originally transmitted, the receiving node can detect errors.

Cross Connection - a mapping between two channels or paths at a network device such as the *CellPath* 300.

CD (Controlled Slip) - a situation in which one frame's worth of data is either lost or replicated. A controlled slip typically occurs when the sending device and receiving device are not using the same clock.

CS (Convergence Sublayer) - a portion of the AAL. Data is passed first to the CS where it is divided into rational, fixed-length packets or PDUs (Protocol Data Units). For example, AAL 4 processes user data into blocks that are a maximum of 64 kbytes long.

CTS (Clear To Send) - and RS-232 modem interface control signal (sent from the modem to the DTE on pin 5) which indicates that the attached DTE may begin transmitting; issuance in response to the DTE's RTS.

D4 framing - See SF)

DARPA (Defense Advanced Research Projects Agency) - the US government agency that funded the ARPANET.

Datagram - a packet of information used in a connectionless network service that is routed to its destination using an address included in the datagram's header.

DCE (Data Communications Equipment) - a definition in the RS232C standard that describes the functions of the signals and the physical characteristics of an interface for a communication device such as a modem.

DCS (Digital Cross-connect System) - an electronic patch panel used to route digital signals in a central office.

Demultiplexing - a function performed by a layer entity that identifies and separates SDUs from a single connection to more than one connection (*see* multiplexing).

DFA (DXI Frame Address) - a connection identifier associated with ATM DXI packets that serves the same functions as, and translates directly to, the VPI/VCI on an ATM cell.

DIP Switch (Dual In-line Package) - a device that has two parallel rows of contacts that let the user switch electrical current through a pair of those contacts to on or off. They are used to reconfigure components and peripherals.

DLCI (Data Link Connection Identifier) - a connection identifier associated with frame relay packets that serves the same functions as, and translates directly to, the VPI/VCI on an ATM cell.

Domain Name Server - a computer that converts names to their corresponding Internet numbers. It allows users to telnet or FTP to the name instead of the number.

DNS (Domain Name System) - the distributed name and address mechanism used in the Internet.

DSn (Digital Standard n (0, 1, 1C, 2, and 3)) - a method defining the rate and format of digital hierarchy, with asynchronous data rates defined as follows:

DS0	64kbps	1 voice channel
DS1	1.544Mbps	24 DS0s
DS1C	3.152 Mbps	2 DS1s
DS2	6.312 Mbps	4 DS1s
DS3	44.736 Mbps	28 DS1s

Synchronous data rates (SONET) are defined as:

STS-1/OC-1	51.84 Mbps	28 DS1s or 1 DS3
STS-3/OC-3	155.52 Mbps	3 STS-1s byte interleaved
STS-3c/OC-3c	155.52 Mbps	Concatenated, indivisible payload
STS-12/OC-12	622.08 Mbps	12 STS-1s, 4 STS-3cs, or any mixture
STS-12c/OC-12c	622.08 Mbps	Concatenated, indivisible payload
STS-48/OC-48	2488.32 Mbps	48 STS-1s, 16 STS-3cs, or any mixture

DSR (Data Set Ready) - an RS-232 modem interface control signal (sent from the modem to the DTE on pin 6) which indicates that the modem is connected to the telephone circuit. Usually a prerequisite to the DTE issuing RTS.

DTE (Data Terminal Equipment) - generally user devices, such as terminals and computers, that connect to data circuit-terminating equipment. They either generate or receive the data carried by the network.

DTR (Data Terminal Ready) - an RS232 modem interface control signal (sent from the DTE to the modem on pin 20) which indicates that the DTE is ready for data transmission and which requests that the modem be connected to the telephone circuit.

DXI - a generic phrase used in the full names of several protocols, all commonly used to allow a pair of DCE and DTE devices to share the implementation of a particular WAN protocol. The protocols all define the packet formats used to transport data packets between DCE and DTE devices.

E1 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 2.048 Mbps. E1 lines can be leased for private use from common carriers.

E3 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 34.368 Mbps. E3 lines can be leased for private use from common carriers.

EEPROM (Electrically Erasable Programmable Read Only Memory) - an EPROM that can be cleared with electrical signals rather than the traditional ultraviolet light.

EFCI (Explicit Forward Congestion Indication) - the second bit of the payload type field in the header of an ATM cell, the EFCI bit indicates network congestion to receiving hosts. On a congested switch, the EFCI bit is set to "1" by the transmitting network module when a certain number of cells have accumulated in the network module's shared memory buffer. When a cell is received that has its EFCI bit set to "1," the receiving host notifies the sending host, which should then reduce its transmission rate.

EGP (Exterior Gateway) Protocol - used by gateways in an internet, connecting autonomous networks.

EIA (Electronics Industries Association) - a USA trade organization that issues its own standards and contributes to ANSI; developed RS-232. Membership includes USA manufacturers.

EISA (Extended Industry Standard Architecture) - a bus architecture for desktop computers that provides a 32-bit data passage while maintaining compatibility with the ISA or AT architecture.

elarp - a FORE program that shows and manipulates MAC and ATM address mappings for LAN Emulation Clients (LECs).

elconfig - a FORE program that shows and modifies LEC configuration. Allows the user to set the NSAP address of the LAN Emulation Configuration Server (LECS), display the list of Emulated LANs (ELANs) configured in the LECS for this host, display the list of ELANs locally configured along with the membership state of each, and locally administer ELAN membership.

EM - the *CellPath* 300 extension module; paired with the system controller and supporting an optional PCMCIA card.

Embedded SNMP Agent - an SNMP agent can come in two forms: embedded or proxy. An embedded SNMP agent is integrated into the physical hardware and software of the unit. The *CellPath* 300 has an internal, integrated SNMP agent.

EMI (Electromagnetic Interference) - signals generated and radiated by an electronic device that cause interference with radio communications, among other effects.

End-to-End Connection - when used in reference to an ATM network, a connection that travels through an ATM network, passing through various ATM devices and with endpoints at the termination of the ATM network.

EPROM - Erasable Programmable Read Only Memory (*see* PROM).

EQL (Equalization) - the process of compensating for line distortions.

ES (End System) - a system in which an ATM connection is terminated or initiated. An originating end system initiates the ATM connection, and a terminating end system terminates the ATM connection. OAM cells may be generated and received.

ES (Errored Seconds) - a second during which at least one code violation occurred.

ESF (Extended Superframe) - T1 framing standard that provides frame synchronization, cyclic redundancy, and data link bits.

Ethernet - a 10-Mbps, coaxial standard for LANs in which all nodes connect to the cable where they contend for access.

Fairness - as related to Generic Flow Control (GFC), fairness is defined as meeting all of the agreed quality of service (QoS) requirements by controlling the order of service for all active connections.

Far-End - in a relationship between two devices in a circuit, the far-end device is the one that is remote.

FCC - a board of commissioners appointed by the President under the Communications Act of 1934, with the authority to regulate all interstate telecommunications originating in the United States, including transmission over phone lines.

FDDI (Fiber Distributed Data Interface) - high-speed data network that uses fiber-optic as the physical medium. Operates in similar manner to Ethernet or Token Ring, only faster.

FDM (Frequency Division Multiplexing) - a method of dividing an available frequency range into parts with each having enough bandwidth to carry one channel.

FEBE (Far End Block Error) - an error detected by extracting the 4-bit FEBE field from the path status byte (G1). The legal range for the 4-bit field is between 0000 and 1000, representing zero to eight errors. Any other value is interpreted as zero errors.

FECN (Forward Explicit Congestion Notification) - bit set by a Frame Relay network to inform data terminal equipment (DTE) receiving the frame that congestion was experienced in the path from source to destination. DTE receiving frames with the FECN bit set can request that higher-level protocols take flow control action as appropriate. Compare with *BECN*.

FERF (Far End Receive Failure) - a line error asserted when a 110 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. A line FERF is removed when any pattern other than 110 is detected in these bits for five consecutive frames.

FIFO (First-In, First-Out) - a method of coordinating the sequential flow of data through a buffer.

Flag - a specific bit pattern used to identify the beginning or end of a frame.

Frame - a variable length group of data bits with a specific format containing flags at the beginning and end to provide demarcation.

Frame Relay - a fast packet switching protocol based on the LAPD protocol of ISDN that performs routing and transfer with less overhead processing than X.25.

Frame Synchronization Error - an error in which one or more time slot framing bits are in error.

Framing - a protocol that separates incoming bits into identifiable groups so that the receiving multiplexer recognizes the grouping.

FT-PNNI (ForeThought PNNI) - a FORE Systems routing and signalling protocol that uses private ATM (NSAP) addresses; a precursor to ATM Forum PNNI (*see* PNNI).

FTP (File Transfer Protocol) - a TCP/IP protocol that lets a user on one computer access, and transfer data to and from, another computer over a network. ftp is usually the name of the program the user invokes to accomplish this task.

GCRA (Generic Cell Rate Algorithm) - an algorithm which is employed in traffic policing and is part of the user/network service contract. The GCRA is a scheduling algorithm which ensures that cells are marked as *conforming* when they arrive when expected or later than expected and *non-conforming* when they arrive sooner than expected.

GFC (Generic Flow Control) - the first four bits of the first byte in an ATM cell header. Used to control the flow of traffic across the User-to-Network Interface (UNI), and thus into the network. Exact mechanisms for flow control are still under investigation and no explicit definition for this field exists at this time. (This field is used only at the UNI; for NNI-NNI use (between network nodes), these four bits provide additional network address capacity, and are appended to the VPI field.)

GIO - a proprietary bus architecture used in certain Silicon Graphics, Inc. workstations.

Header - protocol control information located at the beginning of a protocol data unit.

HDB3 (High Density Bipolar) - line-code type standard for T1 where each block of three zeros is replaced by 00V or B0V, where B represents an inserted pulse conforming to the AMI rule (ITU-T G.701, item 9004) and V represents an AMI violation (ITU-T G.701, item 9007). The choice of 00V or B0V is made so that the number of B pulses between consecutive V pulses is odd (successive V pulses are of alternate polarity so that no d.c. component is introduced). Compare with *AMI*.

HDLC (High-Level Data Link Control) - Bit-oriented synchronous data link layer protocol developed by the ISO. Derived from SDLC, HDLC specifies a data encapsulation method on synchronous serial links using frame characters and checksums. See also *SDLC*.

HEC (Header Error Control) - a CRC code located in the last byte of an ATM cell header that is used for checking cell integrity only.

HIPPI (High Performance Parallel Interface) - ANSI standard that extends the computer bus over fairly short distances at speeds of 800 and 1600 Mbps.

HPUX - the Hewlett-Packard version of UNIX.

HSSI (High-Speed Serial Interface) - a serial communications connection that operates at speeds of up to 1.544 Mbps.

Hub - a device that connects several other devices, usually in a star topology.

I/O Module - FORE's interface cards for the LAX-20 LAN Access Switch, designed to connect Ethernet, Token Ring, and FDDI LANs to *ForeRunner* ATM networks.

ICMP (Internet Control Message Protocol) - the protocol that handles errors and control messages at the IP layer. ICMP is actually a part of the IP protocol layer. It can generate error messages, test packets, and informational messages related to IP.

IEEE (Institute of Electrical and Electronics Engineers) - the world's largest technical professional society. Based in the U.S., the IEEE sponsors technical conferences, symposia & local meetings worldwide, publishes nearly 25% of the world's technical papers in electrical, electronics & computer engineering, provides educational programs for members, and promotes standardization.

IETF (Internet Engineering Task Force) - a large, open, international community of network designers, operators, vendors and researchers whose purpose is to coordinate the operation, management and evolution of the Internet to resolve short- and mid-range protocol and architectural issues.

ILMI (Interim Local Management Interface) - the standard that specifies the use of the Simple Network Management Protocol (SNMP) and an ATM management information base (MIB) to provide network status and configuration information.

Interface Data - the unit of information transferred to/from the upper layer in a single interaction across a SAP. Each Interface Data Unit (IDU) controls interface information and may also contain the whole or part of the SDU.

internet - while an internet is a network, the term "internet" is usually used to refer to a collection of networks interconnected with routers.

Internet - (note the capital "I") the largest internet in the world including large national backbone nets and many regional and local networks worldwide. The Internet uses the TCP/IP suite. Networks with only e-mail connectivity are not considered on the Internet.

Internet Addresses - the numbers used to identify hosts on an internet network. Internet host numbers are divided into two parts; the first is the network number and the second, or local, part is a host number on that particular network. There are also three classes of networks in the Internet, based on the number of hosts on a given network. Large networks are classified as Class A, having addresses in the range 1-126 and having a maximum of 16,387,064 hosts. Medium networks are classified as Class B, with addresses in the range 128-191 and with a maximum of 64,516 hosts. Small networks are classified as Class C, having addresses in the range 192-254 with a maximum of 254 hosts. Addresses are given as dotted decimal numbers in the following format:

nnn.nnn.nnn

In a Class A network, the first of the numbers is the network number, the last three numbers are the local host address.

In a Class B network, the first two numbers are the network, the last two are the local host address.

In a Class C network, the first three numbers are the network address, the last number is the local host address.

The following table summarizes the classes and sizes:

<u>Class</u>	<u>First #</u>	Max# Hosts
A	1-126	16,387,064
В	129-191	64,516
C	192-223	254

Network mask values are used to identify the network portion and the host portion of the address. For:

Class A - the default mask is 255.0.0.0

Class B - the default mask is 255.255.0.0

Class C - the default mask is 255.255.255.0

Subnet masking is used when a portion of the host ID is used to identify a subnetwork. For example, if a portion of a Class B network address is used for a subnetwork, the mask could be set as 255.255.255.0. This would allow the third byte to be used as a subnetwork address. All hosts on the network would still use the IP address to get on the Internet.

IP (Internet Protocol) - a connectionless, best-effort packet switching protocol that offers a common layer over dissimilar networks.

IP Address - a unique 32-bit integer used to identify a device in an IP network. You will most commonly see IP addresses written in "dot" notation; for instance, 192.228.32.14 (*see* IP netmask).

IP Netmask - a pattern of 32 bits that is combined with an IP address to determine which bits of an IP address denote the network number and which denote the host number. Netmasks are useful for sub-dividing IP networks. IP netmasks are written in "dot" notation; for instance, 255.255.255.0 (*see* IP address).

IPX Protocol (Internetwork Packet Exchange) - a NetWare protocol similar to the Xerox Network Systems (XNS) protocol that provides datagram delivery of messages.

IS (Intermediate system) - a system that provides forwarding functions or relaying functions or both for a specific ATM connection. OAM cells may be generated and received.

ISA Bus - a bus standard developed by IBM for expansion cards in the first IBM PC. The original bus supported a data path only 8 bits wide. IBM subsequently developed a 16-bit version for its AT class computers. The 16-bit AT ISA bus supports both 8- and 16-bit cards. The 8-bit bus is commonly called the PC/XT bus, and the 16-bit bus is called the AT bus.

ISDN (Integrated Services Digital Network) - an emerging technology that is beginning to be offered by the telephone carriers of the world. ISDN combines voice and digital network services into a single medium or wire.

ISO (International Standards Organization) - a voluntary, non treaty organization founded in 1946 that is responsible for creating international standards in many areas, including computers and communications.

Isochronous - signals carrying embedded timing information or signals that are dependent on uniform timing; usually associated with voice and/or video transmission.

ITU (International Telecommunications Union) - the telecommunications agency of the United Nations, established to provide standardized communications procedures and practices, including frequency allocation and radio regulations, on a worldwide basis.

J2 - Wide-area digital transmission scheme used predominantly in Japan that carries data at a rate of 6.312 Mbps.

Jitter - analog communication line distortion caused by variations of a signal from its reference timing position.

Jumper - a patch cable or wire used to establish a circuit, often temporarily, for testing or diagnostics; also, the devices, shorting blocks, used to connect adjacent exposed pins on a printed circuit board that control the functionality of the card.

LAN (Local Area Network) - a data network intended to serve an area of only a few square kilometers or less. Because the network is known to cover only a small area, optimizations can be made in the network signal protocols that permit higher data rates.

lane - a program that provides control over the execution of the LAN Emulation Server (LES), Broadcast/Unknown Server (BUS), and LAN Emulation Configuration Server (LECS) on the local host.

LAN Access Concentrator - a LAN access device that allows a shared transmission medium to accommodate more data sources than there are channels currently available within the transmission medium.

LAPB (Link Access Procedure, Balanced) - Data link protocol in the X.25 protocol stack. LAPB is a bit-oriented protocol derived from HDLC. See also HDLC and X.25.

LAX-20 - a FORE Systems LAN Access Switch, designed to connect Ethernet, Token Ring, and FDDI LANs to *ForeRunner* ATM networks. The LAX-20 is a multiport, multiprotocol internetworking switch that combines the advantages of a high-performance LAN switch and a full-featured ATM interface capable of carrying LAN traffic.

Layer Entity - an active layer within an element.

Layer Function - a part of the activity of the layer entities.

Layer Service - a capability of a layer and the layers beneath it that is provided to the upper layer entities at the boundary between that layer and the next higher layer.

Layer User Data - the information transferred between corresponding entities on behalf of the upper layer or layer management entities for which they are providing services.

le - a FORE program that implements both the LAN Emulation Server (LES) and the Broadcast/Unknown Server (BUS).

LEC (LAN Emulation Client) - the component in an end system that performs data forwarding, address resolution, and other control functions when communicating with other components within an ELAN.

lecs - a FORE program that implements the assignment of individual LECs to different emulated LANs.

LECS (LAN Emulation Configuration Server) - the LECS is responsible for the initial configuration of LECs. It provides information about available ELANs that a LEC may join, together with the addresses of the LES and BUS associated with each ELAN.

 ${f leq}$ - a FORE program that provides information about an ELAN. This information is obtained from the LES, and includes MAC addresses registered on the ELAN together with their corresponding ATM addresses.

LES (LAN Emulation Server) - the LES implements the control coordination function for an ELAN. The LES provides the service of registering and resolving MAC addresses to ATM addresses.

Link Down Trap - a *CellPath* 300 SNMP trap that signifies that the Ethernet interface has transitioned from a normal state to an error state, or has been disconnected.

Link Up Trap - a *CellPath* 300 SNMP trap that signifies that the Ethernet interface has transitioned from an error condition to a normal state.

LLC (Logical Link Control) - a protocol developed by the IEEE 802 committee for data-link-layer transmission control; the upper sublayer of the IEEE Layer 2 (OSI) protocol that complements the MAC protocol; IEEE standard 802.2; includes end-system addressing and error checking.

LOF (Loss Of Frame) - a type of transmission error that may occur in wide-area carrier lines.

Loopback - a troubleshooting technique that returns a transmitted signal to its source so that the signal can be analyzed for errors. Typically, a loopback is set at various points in a line until the section of the line that is causing the problem is discovered.

looptest - a program that tests the interface for basic cell reception and transmission functionality. It is usually used for diagnostic purposes to determine if an interface is functioning properly.

LOP (Loss Of Pointer) - a type of transmission error that may occur in wide-area carrier lines.

LOS (Loss Of Signal) - a type of transmission error that may occur in wide-area carrier lines.

MAC (Media Access Control) - a media-specific access control protocol within IEEE 802 specifications; currently includes variations for Token Ring, token bus, and CSMA/CD; the lower sublayer of the IEEE's link layer (OSI), which complements the Logical Link Control (LLC).

MAU (Media Attachment Unit) - device used in Ethernet and IEEE 802.3 networks that provides the interface between the AUI port of a station and the common medium of the Ethernet. The MAU, which can be built into a station or can be a separate device, performs physical layer functions including conversion of the digital data from the Ethernet interface, collision detection, and injection of bits onto the network.

Maximum Burst Tolerance - the largest burst of data that a network device is guaranteed to handle without discarding cells or packets. Bursts of data larger than the maximum burst size may be subject to discard.

MCR (Minimum Cell Rate) - parameter defined by the ATM Forum for ATM traffic management. MCR is defined only for ABR transmissions, and specifies the minimum value for the ACR.

Metasignalling - an ATM Layer Management (LM) process that manages different types of signalling and possibly semipermanent virtual channels (VCs), including the assignment, removal, and checking of VCs.

Metasignalling VCs - the standardized VCs that convey metasignalling information across a User-to-Network Interface (UNI).

MIB (Management Information Base) - the set of parameters that an SNMP management station can query or set in the SNMP agent of a networked device (e.g., router).

MIC (Media Interface Connector) - the optical fiber connector that joins the fiber to the FDDI controller.

MicroChannel - a proprietary 16- or 32-bit bus developed by IBM for its PS/2 computers' internal expansion cards; also offered by others.

MTU (Maximum Transmission Unit) - the largest unit of data that can be sent over a type of physical medium.

Multi-homed - a device that has both an ATM and another network connection, typically Ethernet.

Multiplexing - a function within a layer that interleaves the information from multiple connections into one connection (*see* demultiplexing).

Multipoint Access - user access in which more than one terminal equipment (TE) is supported by a single network termination.

Multipoint-to-Point Connection - a Point-to-Multipoint Connection may have zero bandwidth from the Root Node to the Leaf Nodes, and non-zero return bandwidth from the Leaf Nodes to the Root Node. Such a connection is also known as a Multipoint-to-Point Connection.

Multipoint-to-Multipoint Connection - a collection of associated ATM VC or VP links, and their associated endpoint nodes, with the following properties:

- 1. All N nodes in the connection, called Endpoints, serve as a Root Node in a Point-to-Multipoint connection to all of the (N-1) remaining endpoints.
- 2. Each of the endpoints can send information directly to any other endpoint, but the receiving endpoint cannot distinguish which of the endpoints is sending information without additional (e.g., higher layer) information.

Near-End - in a relationship between two devices in a circuit, the near-end device is the one that is local.

Network Module - ATM port interface cards which may be individually added or removed from any *ForeRunner* ATM switch to provide a diverse choice of connection alternatives. Each network module provides between one and six full-duplex ATM physical connections to the *ForeRunner* switch.

NMS (Network Management Station) - the system responsible for managing a network or a portion of a network. The NMS talks to network management agents, which reside in the managed nodes.

NNI (Network-to-Network Interface or Network Node Interface) - the interface between two public network pieces of equipment.

nonvolatile - a term used to describe a data storage device (memory) that retains its contents when power is lost.

NuBus - a high-speed bus used in the Macintosh family of computers, structured so that users can put a card into any slot on the board without creating conflict over the priority between those cards

OAM (Operation and Maintenance) Cell - a cell that contains ATM LM information. It does not form part of the upper layer information transfer.

octet - a grouping of 8 bits; similar, but not identical, to a byte.

OID (Object Identifier) - the address of a MIB variable.

OOF (Out-of-Frame) - a signal condition and alarm in which some or all framing bits are lost.

OpenView - Hewlett-Packard's network management software.

OSI (Open Systems Interconnection) - the 7-layer suite of protocols designed by ISO committees to be the international standard computer network architecture.

OSPF (Open Shortest Path First) Protocol - a routing algorithm for IP that incorporates least-cost, equal-cost, and load balancing.

Out-of-Band Management - refers to switch configuration via the serial port or over Ethernet. not ATM.

packet - a group of bits - including information bits and overhead bits - transmitted as a complete package on a network. Usually smaller than a transmission block.

Packet Port - a port on the *CellPath* 300 that transmits and receives packet traffic.

Packet Switching - a communications paradigm in which packets (messages) are individually routed between hosts with no previously established communications path.

Payload Scrambling - a technique that eliminates certain bit patterns that may occur within an ATM cell payload that could be misinterpreted by certain sensitive transmission equipment as an alarm condition.

PBX (Private Branch Exchange) - a private phone system (switch) that connects to the public telephone network and offers in-house connectivity. To reach an outside line, the user must dial a digit like 8 or 9.

PCI (Peripheral Component Interconnect) - a local-bus standard created by Intel.

PCM (Pulse Code Modulation) - a modulation scheme that samples the information signals and transmits a series of coded pulses to represent the data.

PCR (Peak Cell Rate) - parameter defined by the ATM Forum for ATM traffic management. In CBR transmissions, PCR determines how often data samples are sent. In ABR transmissions, PCR determines the maximum value of the ACR.

PDN (Public Data Network) - a network designed primarily for data transmission and intended for sharing by many users from many organizations.

PDU (Protocol Data Unit) - a unit of data specified in a layer protocol and consisting of protocol control information and layer user data.

Peak Cell Rate - at the PHY Layer SAP of a point-to-point VCC, the Peak Cell Rate Rpis the inverse of the minimum inter-arrival time T0 of the request to send an ATM-SDU.

Peer Entities - entities within the same layer.

PHY (Physical Layer) - the actual cards, wires, and/or fiber-optic cabling used to connect computers, routers, and switches.

Physical Layer (PHY) Connection - an association established by the PHY between two or more ATM-entities. A PHY connection consists of the concatenation of PHY links in order to provide an end-to-end transfer capability to PHY SAPs.

PLCP (Physical Layer Convergence Protocol) - a framing protocol that runs on top of the T1 or E1 framing protocol.

PLM (Physical Layer Module) - interface card in the *CellPath* 300 that provides the logic to support the physical layer of the network link. A PLM has the actual physical port mounted on it. Various PLMs support various physical layers, such as OC-3c/STM1 or DS3.

PLP (Packet Level Protocol) - Network layer protocol in the X.25 protocol stack. Sometimes called X.25 Level 3 or X.25 Protocol. See also X.25.

PM (**Protocol Module**) - interface card in the *CellPath* 300 that provides the logic supporting the protocol layer of the network link. Various PMs support various protocols, such as ATM cell, Frame Relay, or CBR traffic.

PMD (Physical Medium Dependent) - a sublayer concerned with the bit transfer between two network nodes. It deals with wave shapes, timing recovery, line coding, and electro-optic conversions for fiber based links.

PNNI (Private Network Node Interface or Private Network-to-Network Interface) - a protocol that defines the interaction of private ATM switches or groups of private ATM switches

ping (Packet Internet Groper) - a program used to test reachability of destinations by sending them an ICMP echo request and waiting for a reply.

Point-to-Multipoint Connection - a collection of associated ATM VC or VP links, with associated endpoint nodes, with the following properties:

- 1. One ATM link, called the Root Link, serves as the root in a simple tree topology. When the Root node sends information, all of the remaining nodes on the connection, called Leaf nodes, receive copies of the information.
- 2. Each of the Leaf Nodes on the connection can send information directly to the Root Node. The Root Node cannot distinguish which Leaf is sending information without additional (higher layer) information. (See the following note for Phase 1.)
- 3. The Leaf Nodes cannot communicate directly to each other with this connection type.

Note: Phase 1 signalling does not support traffic sent from a Leaf to the Root.

Point-to-Point Connection - a connection with only two endpoints.

Point of Demarcation - the dividing line between a carrier and the customer premise that is governed by strict standards that define the characteristics of the equipment on each side of the demarcation. Equipment on one side of the point of demarcation is the responsibility of the customer. Equipment on the other side of the point of demarcation is the responsibility of the carrier.

Policing - the function that ensures that a network device does not accept traffic that exceeds the configured bandwidth of a connection.

Primitive - an abstract, implementation-independent interaction between a layer service user and a layer service provider.

Priority - the parameter of ATM connections that determines the order in which they are reduced from the peak cell rate to the sustained cell rate in times of congestion. Connections with lower priority (4 is low, 1 is high) are reduced first.

PROM (Programmable Read-Only Memory) - a chip-based information storage area that can be recorded by an operator but erased only through a physical process.

Protocol - a set of rules and formats (semantic and syntactic) that determines the communication behavior of layer entities in the performance of the layer functions.

Protocol Control Information - the information exchanged between corresponding entities using a lower layer connection to coordinate their joint operation.

Proxy - the process in which one system acts for another system to answer protocol requests.

Proxy Agent - an agent that queries on behalf of the manager, used to monitor objects that are not directly manageable.

PSN (Packet Switched Network) - a network designed to carry data in the form of packets. The packet and its format is internal to that network.

PT (Payload Type) - bits 2...4 in the fourth byte of an ATM cell header. The PT indicates the type of information carried by the cell. At this time, values 0...3 are used to identify various types of user data, values 4 and 5 indicate management information, and values 6 and 7 are reserved for future use.

PVC (Permanent Virtual Circuit (or Channel)) - a circuit or channel through an ATM network provisioned by a carrier between two endpoints; used for dedicated long-term information transport between locations.

Q.2931 - Derived from Q.93B, the narrowband ISDN signalling protocol, an ITU standard describing the signalling protocol to be used by switched virtual circuits on ATM LANs.

Real-Time Clock - a clock that maintains the time of day, in contrast to a clock that is used to time the electrical pulses on a circuit.

Relaying - a function of a layer by means of which a layer entity receives data from a corresponding entity and transmits it to another corresponding entity.

RFCs (Requests For Comment) - IETF documents suggesting protocols and policies of the Internet, inviting comments as to the quality and validity of those policies. These comments are collected and analyzed by the IETF in order to finalize Internet standards.

RFI (Radio Frequency Interference) - the unintentional transmission of radio signals. Computer equipment and wiring can both generate and receive RFI.

RIP (Routing Information Protocol) - a distance vector-based protocol that provides a measure of distance, or hops, from a transmitting workstation to a receiving workstation.

RISC (Reduced Instruction Set Computer) - a generic name for CPUs that use a simpler instruction set than more traditional designs.

Router - a device that forwards traffic between networks or subnetworks based on network layer information.

RTS (Request To Send) - an RS-232 modem interface signal (sent from the DTE to the modem on pin 4) which indicates that the DTE has data to transmit.

SBus - hardware interface for add-in boards in later-version Sun 3 workstations.

SAP (Service Access Point) - the point at which an entity of a layer provides services to its LM entity or to an entity of the next higher layer.

SAR (Segmentation And Reassembly) - the SAR accepts PDUs from the CS and divides them into very small segments (44 bytes long). If the CS-PDU is less than 44 bytes, it is padded to 44 with zeroes. A two-byte header and trailer are added to this basic segment. The header identifies the message type (beginning, end, continuation, or single) and contains sequence numbering and message identification. The trailer gives the SAR-PDU payload length, exclusive of pad, and contains a CRC check to ensure the SAR-PDU integrity. The result is a 48-byte PDU that fits into the payload field of an ATM cell.

SC - *CellPath* 300 System Controller; paired with the Extension Module (EM).

SCR (sustainable cell rate) - parameter defined by the ATM Forum for ATM traffic management. For VBR connections, SCR determines the long-term average cell rate that can be transmitted.

SCSI (Small Computer Systems Interface) - a standard for a controller bus that connects disk drives and other devices to their controllers on a computer bus. It is typically used in small systems.

SDLC (Synchronous Data Link Control) - IBM's data link protocol used in SNA networks.

SDU (Service Data Unit) - a unit of interface information whose identity is preserved from one end of a layer connection to the other.

SEAL (Simple and Efficient Adaptation Layer) - also called AAL 5, this ATM adaptation layer assumes that higher layer processes will provide error recovery, thereby simplifying the SAR portion of the adaptation layer. Using this AAL type packs all 48 bytes of an ATM cell information field with data. It also assumes that only one message is crossing the UNI at a time. That is, multiple end-users at one location cannot interleave messages on the same VC, but must queue them for sequential transmission.

Segment - a single ATM link or group of interconnected ATM links of an ATM connection.

Semipermanent Connection - a connection established via a service order or via network management.

SES (Severely Errored Seconds) - a second during which more event errors have occurred than the SES threshold.

SF (Superframe) - Common framing type used on T1 circuits. SF consists of 12 frames of 192 bits each, with the 193rd bit providing error checking and other functions. SF has been superseded by ESF, but is still widely used. Also called *D4 framing*. See also ESF.

SGMP (Simple Gateway Management Protocol) - the predecessor to SNMP.

Shaping Descriptor - *n* ordered pairs of GCRA parameters (I,L) used to define the negotiated traffic shape of an APP connection. The traffic shape refers to the load-balancing of a network. In this context, load-balancing means configuring the data flows to maximize the efficiency of the network.

SIR (Sustained Information Rate) - the long-term average data transmission rate across the User-to-Network Interface.

SMDS (Switched Multimegabit Data Service) - a high-speed, datagram-based, public data network service expected to be widely used by telephone companies in their data networks.

SMTP (Simple Mail Transfer Protocol) - the Internet electronic mail protocol used to transfer electronic mail between hosts.

SNAP - SubNetwork Access Protocol

SNMP (Simple Network Management Protocol) - the Internet standard protocol for managing nodes on an IP network.

snmpd - an SMNP agent for a given adapter card.

SONET (Synchronous Optical Network) - a new and growing body of standards that defines all aspects of transporting and managing digital traffic over optical facilities in the public network.

Source Traffic Descriptor - a set of traffic parameters belonging to the ATM Traffic Descriptor used during the connection set-up to capture the intrinsic traffic characteristics of the connection requested by the source.

Spanning Tree Protocol - provides loop-free topology in a network environment where there are redundant paths.

SPANS (Simple Protocol for ATM Network Signalling) - FORE Systems' proprietary signalling protocol used for establishing SVCs between FORE Systems equipment.

SPARC (Scalable Processor Architecture Reduced instruction set Computer) - a powerful workstation similar to a reduced-instruction-set-computing (RISC) workstation.

SPE (Synchronous Payload Envelope) - the payload field plus a little overhead of a basic SONET signal.

SPVC (Smart PVC) - a generic term for any communications medium which is permanently provisioned at the end points, but switched in the middle. In ATM, there are two kinds of SPVCs: smart permanent virtual path connections (SPVPCs) and smart permanent virtual channel connections (SPVCCs).

Static Route - a route that is entered manually into the routing table.

Statistical Multiplexing - a technique for allowing multiple channels and paths to share the same link, typified by the ability to give the bandwidth of a temporarily idle channel to another channel.

STM (Synchronous Transfer Mode) - a transport and switching method that depends on information occurring in regular and fixed patterns with respect to a reference such as a frame pattern.

STP (Shielded Twisted Pair) - two or more insulated wires that are twisted together and then wrapped in a cable with metallic braid or foil to prevent interference and offer noise-free transmissions.

STS (Synchronous Transport Signal) - a SONET electrical signal rate.

Sublayer - a logical subdivision of a layer.

Super User - a login ID that allows unlimited access to the full range of a device's functionality, including especially the ability to reconfigure the device and set passwords.

SVC (Switched Virtual Circuit (or Channel)) - a channel established on demand by network signalling, used for information transport between two locations and lasting only for the duration of the transfer; the datacom equivalent of a dialed telephone call.

Switched Connection - a connection established via signalling.

Symmetric Connection - a connection with the same bandwidth value specified for both directions.

Synchronous - signals that are sourced from the same timing reference and hence are identical in frequency.

Systems Network Architecture (SNA) - a proprietary networking architecture used by IBM and IBM-compatible mainframe computers.

T1 - a specification for a transmission line. The specification details the input and output characteristics and the bandwidth. T1 lines run at 1.544 Mbps and provide for 24 data channels. In common usage, the term "T1" is used interchangeably with "DS1."

T3 - a specification for a transmission line, the equivalent of 28 T1 lines. T3 lines run at 44.736 Mbps. In common usage, the term "T3" is used interchangeably with "DS3."

Tachometer - in *ForeView*, the tachometer shows the level of activity on a given port. The number in the tachometer shows the value of a chosen parameter in percentage, with a colored bar providing a semi-logarithmic representation of that percentage.

TAXI (Transparent Asynchronous Transmitter/Receiver Interface) - Encoding scheme used for FDDI LANs as well as for ATM; supports speeds of up to 100 Mbps over multimode fiber.

TC (Transmission Convergence) - generates and receives transmission frames and is responsible for all overhead associated with the transmission frame. The TC sublayer packages cells into the transmission frame.

TCP (Transmission Control Protocol) - a specification for software that bundles and unbundles sent and received data into packets, manages the transmission of packets on a network, and checks for errors.

TCP/IP (Transmission Control Protocol/Internet Protocol) - a set of communications protocols that has evolved since the late 1970s, when it was first developed by the Department of Defense. Because programs supporting these protocols are available on so many different computer systems, they have become an excellent way to connect different types of computers over networks.

TDM (Time Division Multiplexing) - a method of traditional digital multiplexing in which a signal occupies a fixed, repetitive time slot within a higher-rate signal.

Telnet - a TCP/IP protocol that defines a client/server mechanism for emulating directly-connected terminal connections.

Token Ring - a network access method in which the stations circulate a token. Stations with data to send must have the token to transmit their data.

topology - a program that displays the topology of a FORE Systems ATM network. An updated topology can be periodically re-displayed by use of the interval command option.

Traffic - the calls being sent and received over a communications network. Also, the packets that are sent on a data network.

Trailer - the protocol control information located at the end of a PDU.

Transit Delay - the time difference between the instant at which the first bit of a PDU crosses one designated boundary, and the instant at which the last bit of the same PDU crosses a second designated boundary.

trap - a program interrupt mechanism that automatically updates the state of the network to remote network management hosts. The SNMP agent on the switch supports these SNMP traps.

UAS (Unavailable Seconds) - a measurement of signal quality. Unavailable seconds start accruing when ten consecutive severely errored seconds occur.

UBR (Unspecified Bit Rate) - a type of traffic that is not considered time-critical (e.g., ARP messages, pure data), allocated whatever bandwidth is available at any given time. UBR traffic is given a "best effort" priority in an ATM network with no guarantee of successful transmission.

UDP (User Datagram Protocol) - the TCP/IP transaction protocol used for applications such as remote network management and name-service access; this lets users assign a name, such as "RVAX*2,S," to a physical or numbered address.

Unassigned Cells - a generated cell identified by a standardized virtual path identifier (VPI) and virtual channel identifier (VCI) value, which does not carry information from an application using the ATM Layer service.

UNI (User-to-Network Interface) - the physical and electrical demarcation point between the user and the public network service provider.

UNI 3.0 - the User-to-Network Interface standard set forth by the ATM Forum that defines how private customer premise equipment interacts with private ATM switches.

UPC (Usage Parameter Control) - the mechanism that ensures that traffic on a given connection does not exceed the contracted bandwidth of the connection. UPC is responsible for policing or enforcement. UPC is sometimes confused with congestion management, to which it is functionally related on the *CellPath* 300 (*see* congestion management).

UTP (Unshielded Twisted Pair) - a cable that consists of two or more insulated conductors in which each pair of conductors are twisted around each other. There is no external protection and noise resistance comes solely from the twists.

V.35 - ITU-T standard describing a synchronous, physical layer protocol used for communications between a network access device and a packet network. V.35 is most commonly used in the United States and Europe, and is recommended for speeds up to 48 Kbps.

VBR (Variable Bit Rate) - a type of traffic that, when sent over a network, is tolerant of delays and changes in the amount of bandwidth it is allocated (e.g., data applications).

VC (Virtual Channel (or Circuit)) - a communications path between two nodes identified by label rather than fixed physical path.

VCC (Virtual Channel Connection) - a unidirectional concatenation of VCLs that extends between the points where the ATM service users access the ATM Layer. The points at which the ATM cell payload is passed to, or received from, the users of the ATM Layer (i.e., a higher layer or ATMM-entity) for processing signify the endpoints of a VCC.

VCI (Virtual Channel Identifier) - the address or label of a VC; a value stored in a field in the ATM cell header that identifies an individual virtual channel to which the cell belongs. VCI values may be different for each data link hop of an ATM virtual connection.

VCL (Virtual Channel Link) - a means of unidirectional transport of ATM cells between the point where a VCI value is assigned and the point where that value is translated or removed.

VINES (Virtual Network Software) - Banyan's network operating system based on UNIX and its protocols.

Virtual Channel Switch - a network element that connects VCLs. It terminates VPCs and translates VCI values. The Virtual Channel Switch is directed by Control Plane functions and relays the cells of a VC.

Virtual Connection - an endpoint-to-endpoint connection in an ATM network. A virtual connection can be either a virtual path or a virtual channel.

Virtual Path Switch - a network element that connects VPLs, it translates VPI (not VCI) values and is directed by Control Plane functions. The Virtual Path Switch relays the cells of a Virtual Path.

VPT (Virtual Path Terminator) - a system that unbundles the VCs of a VP for independent processing of each VC.

VP (Virtual Path) - a unidirectional logical association or bundle of VCs.

VPC (Virtual Path Connection) - a concatenation of VPLs between virtual path terminators (VPTs). VPCs are unidirectional.

VPDN (Virtual Private Data Network) - a private data communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

VPI (Virtual Path Identifier) - the address or label of a particular VP; a value stored in a field in the ATM cell header that identifies an individual virtual path to which the cell belongs. A virtual path may comprise multiple virtual channels.

VPL (Virtual Path Link) - a means of unidirectional transport of ATM cells between the point where a VPI value is assigned and the point where that value is translated or removed.

VPN (Virtual Private Network) - a private voice communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

VT (Virtual Tributary) - a structure used to carry payloads such as DS1s that run at significantly lower rates than STS-1s.

WAN (Wide-Area Network) - a network that covers a large geographic area.

Warm Start Trap - a *CellPath* 300 SNMP trap that indicates that SNMP alarm messages or agents have been enabled.

Yellow Alarm - an alarm that occurs on a device when the signal from the device is not received at the far-end.

X.21 - ITU-T standard for serial communications over synchronous digital lines. The X.21 protocol is used primarily in Europe and Japan.

X.25 - ITU-T standard that defines how connections between DTE and DCE are maintained for remote terminal access and computer communications in PDNs. X.25 specifies LAPB, a data link protocol, and PLP, a network layer protocol. Frame Relay has, to some degree, superseded X.25. See also Frame Relay, LAPB, and PLP.

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